

## Appendix D



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*Hibiscus bee*

## Refuge Resources of Concern

Table D-1. Summary of Biological Integrity, Diversity, and Environmental Health (BIDEH) Elements for Prime Hook National Wildlife Refuge  
**I. BARRIER ISLAND BEACH HABITATS – 439 ACRES**      4/3/2012

Habitats and Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Age Class, Structure, Serial Stage, Species Composition)	Natural Processes responsible for these conditions	Limiting Factors
<p><b>Overwash Grassland Dunes: 50 A</b></p>	<p>A series of small dune “fingers” developed at regular intervals, oriented @ 90° to the bay shoreline and protruding into the salt marsh. These overwash and blow-out areas are both recently deposited and devoid of vegetation, or may be older w/ well-established vegetation. <i>Cakile edentula</i>, and <i>Spartina patens</i> are dominants, in early successional expressions of dune overwash. As vegetation develops, other associates found on the refuge include <i>Schoenoplectus pungens</i>, <i>Cenchrus tribuloides</i>, <i>Triplasis purpurea</i> and scattered <i>Baccharis halimifolia</i> seedlings.</p> <p><b>Potential Focal Species:</b> Piping Plover, Red Knot, American Oystercatcher, Sanderling, Least Tern, Black Skimmer, American Black Duck, Willet, Forster’s Tern, Coastal Plain Swamp Sparrow, Common Night Hawk; Horseshoe Crab, Beach-Dune Tiger Beetle, Northern Diamondback Terrapin</p>	<p>Forms a drier, later successional phase beginning from water-deposited sands from storm overwash. Sand movement, plant burial, and dune formation rates differ from dune grasslands dominated by American Beachgrass (<i>Ammophila breviligulata</i>) to other areas with salt meadow cordgrass (<i>Spartina patens</i>) and seaside goldenrod (<i>Solidago sempervirens</i>). Storm overwash and dune blowouts from surf surges and wind erosion are the prevalent natural disturbances of this community.</p>	<p>Overwash dunes of mid-Atlantic barrier island habitats are G2-G3 ranked and DE S2/S3. This community is restricted to overwash dunes developed on coastal beach habitats of DE, MD VA &amp; NC. Restricted to specialized habitat it is threatened by a number of human activities especially artificial dune stabilization.</p>
<p><b>Beachgrass and Panic-grass Dune Grassland Association: 35 A</b></p>	<p>Community is a maritime dune grassland dominated by <i>Ammophila breviligulata</i> or <i>Panicum amarum</i>. Other associated plant species include <i>Solidago sempervirens</i>, <i>Triplasis purpurea</i>, <i>Cenchrus tribuloides</i>, <i>Chamaesyce polygonifolia</i>, <i>Cakile edentula</i>, <i>Nuttallanthus canadensis</i> and <i>Cyperus gragi</i>, where overwashed by sand.</p> <p><b>Potential Focal Species:</b> Beach-Dune Tiger Beetle.</p>	<p>Eolian processes cause active sand deposition and erosion. This community generally occurs on foredunes that receive the force of wind and salt spray, but is beyond the influence of spring tides and most storm surges. Diagonostic plant species are <i>A. breviligulata</i>, <i>S. sempervirens</i> <i>Panicum amarum</i>, and <i>O. punctata humifusa</i>.</p>	<p>Community is globally ranked as G2, found on maritime dunes from Long Island, south to NC. Over this range less than 3,000 acres currently exist. Limiting factors include trampling by people and ATV traffic. This association is highly fragile and does not recover well from these types of human uses and impacts.</p>

Habitats and Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Age Class, Structure, Serial Stage, Species Composition)	Natural Processes responsible for these conditions	Limiting Factors
<p><b>Atlantic Coast Intertidal Swale: 67 A</b></p>	<p>This association occurs on maritime barrier islands' protected backdunes, barrier flats &amp; intertidal swales. Substrate is sand to loamy sand w/ thin layer of organic matter. Vegetation is characterized by moderately open to densely closed canopy of <i>Morella cerifera</i> and short stems of <i>Prunus serotina</i>. Other canopy associates include <i>Baccaris halimifolia</i> and <i>Juniperus virginiana</i> and <i>Rhus copallinum</i>. Herbaceous layer characterized by <i>Spartina patens</i>, <i>Panicum virgatum</i>, <i>Andropogon virginicus</i>, <i>A. virginicus</i> var. <i>hirsutior</i> (S1), <i>Juncus effuses</i>, <i>Polygonum hydropiperoides</i>, &amp; <i>Distichlis spicata</i>.</p> <p><b>Potential Focal Species: <i>Catocala multiercula</i> &amp; other invertebrate fauna dependent on this habitat type &amp; heavily utilized by migratory songbirds.</b></p>	<p>This community is not tidally flooded and occurs beyond the reach of most storm tides, but it is impacted by salt spray, wind erosion and sand movements. (<b>Note:</b>) Reference sites in Delaware = <u>Great Marsh in Lewes &amp; Prime Hook NWR in Milton.</u></p>	<p>Habitat Loss and Fragmentation; Most occurrences near refuge have been destroyed by coastal development of Slaughter, Prime Hook &amp; Broadkill Beach communities, These soils are sandy and dry enough that they are not classified as "jurisdictional wetlands." Remaining occurrences are highly fragmented, represented by very small and isolated patches.</p>
<p><b>Irregularly Flooded Eastern Tidal Salt Shrub: ~ 60 Acres</b></p>	<p>Dominated by <i>Iva frutescens</i> or <i>Baccharis halimifolia</i> or both growing in association with salt marshes. Other associated shrubs include <i>Morella cerifera</i>. <i>Spartina patens</i> is the characteristic dominant grass with other herbaceous associates: <i>Panicum virgatum</i>, <i>Distichlis spicata</i>, <i>Hibiscus moscheutos</i>, <i>Terretrum canadenses</i>, <i>Cuscuta gronovii</i>, &amp; <i>Solidago sempervirens</i>.</p> <p><b>Conservation Target <i>Catocala multiercula</i> (State Record)</b></p>	<p>The tidal shrublands are characteristic of diurnal to irregularly flooded mesohaline (5-18 ppt) systems. Soils are layers of accumulated peat of variable depths overlying sands. Communities occur in estuarine margins and form an ecotone between salt marsh &amp; upland vegetation.</p>	<p>Storm surges can cause shrub die-back. Heavy salt spray &amp; tidal flooding often causes die-back of shrub layer bayward. This association grades into high salt marsh dominated by herbaceous vegetation. Landward, shrub cover becomes denser. Invasive species encroachment problematic. Invertebrate communities susceptible to negative impacts from adulticides (Naled ).</p>

Habitats and Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Age Class, Structure, Serial Stage, Species Composition)	Natural Processes responsible for these conditions	Limiting Factors
<p><b>Maritime Red Cedar Woodland</b> 76 A</p>	<p>Community dominated by red cedars (<i>Juniperus virginiana</i>) of variable heights but trees are generally shorter than 4 meters tall. Trees start to colonize areas behind sand dunes and upper edges of salt marshes. Red cedar either forms pure stands and/or grows in association with <i>Quercus stellata</i>, <i>Prunus serotina</i>, <i>Amelanchier canadensis</i> &amp; <i>Ilex opaca</i>. <i>Pinus taeda</i>, <i>Q. phellos</i> &amp; <i>Diospyros virginiana</i> infrequent canopy associates. In Delaware this NVC community is one of the best remaining examples of this cover-type. This community supports the state rare plant golden heather (<i>Hudsonia ericoides</i> – S1) and its population size is significant as the only other known occurrence on the Delmarva Peninsula was Cape Henlopen State Park. A close relative to golden-heather also occurs here, beach heather (<i>Hudsonia tomentosa</i>). Vegetation community supports unique and uncommon invertebrate fauna listed below:</p> <p><b>Potential Focal Species:</b> <i>Wallengrenia otho</i> (S1), Southern Broken Dash, <i>Drasteria graphica</i> (SIS3) = Good indicator species of high quality Maritime Red Cedar Woodland Habitat; <i>Pompeius verna</i>, Little glassy wing (tier 2) and <i>Anatrytone logan</i>, Delaware skipper (tier 2).</p>	<p>The dominance of red cedar and its maritime location defines this community. Maritime Red Cedar Woodland is influenced by onshore winds and salt spray, sand deposition, and tidal overwash from severe storms. Golden heather grows where soils are hot, sandy and nutrient poor. Plant species diversity is low in these areas due to stressful environmental conditions.</p>	<p>This Coastal Dune community is very rare in DE (S1) and also Globally Rare (G2). Artificial dune stabilization, commercial &amp; residential development as its greatest threats. The invertebrate fauna associated with this community is threatened from annual adulticides applications that occur in and around community locations.</p>

Habitats and Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Age Class, Structure, Serial Stage, Species Composition)	Natural Processes responsible for these conditions	Limiting Factors
<p><b>Successional Maritime Forest (184 A)</b></p>	<p>This community is found on the leeward side of secondary dunes with substrate varying from pure sand directly adjacent to Delaware Bay to well-drained loamy sands in more sheltered areas. Community is a stunted forest of blackcherry, sweetgum, and red maple with a shrub layer dominated by bayberry shrubs (<i>Morella cerifera</i> and <i>persylvanica</i>) plus <i>Smilax rotundifolia</i> the are dominant shrub species. Other associates include <i>Diospyros virginiana</i> and <i>Pinus taeda</i> in varying portions. Where trees from an open canopy the herbaceous layers are diverse and characterized by slender spikegrass (<i>Chasmanthium laxum</i>), stout wood reedgrass (<i>Cinna arundinacea</i>), switchgrass (<i>Panicum virgatum</i>), <i>panic beachgrass</i> (<i>P. amarum</i> var. <i>amarulum</i>), little bluestem (<i>Schizachyrium scoparium</i> [<i>Andropogon scoparius</i>], eastern jointweed (<i>Polygonella articulata</i>), rattlesnake hawkweed (<i>Hieracium venosum</i>), and seaside goldenrod (<i>Solidago sempervirens</i>) . Where trees form a closed canopy herbaceous plants are sparse or lacking.</p> <p><b>Potential Focal Species and identified state species of great conservation need (SGCN): <i>Catocala multiercula</i>.</b></p>	<p>This is a tall deciduous shrub-scrub forest. The physiognomy varies dramatically, ranging from open woodland to stunted forest to dense impenetrable thicket. Individual trees are wind-pruned and multi-stemmed, and are subjected to wind erosion and salt spray to varying degrees. This association occupies a transitional zone between maritime forest and the low maritime shrublands connected to dune associations.</p>	<p>Limited range in mid-Atlantic from VA to north of Cape May, NJ. In Delaware this community is known from the Mispillion River, south into the Inland Bays Region. Historic habitat has been eliminated by human development.</p>

Table D-2. Summary of Biological Integrity, Diversity, and Environmental Health (BIDEH) Elements for Prime Hook National Wildlife Refuge

II. FORESTED HABITATS – UPLAND SITES ~ 775 Acres 4/3/2012

Habitat and Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Structure, Species Composition)	Natural Processes responsible for these conditions	Limiting Factors
<p><b>Southern Red Oak: Heath Forest 289 A</b></p>	<p>Oak forest of unglaciated NE coastal plain. On refuge occurs on well-drained acidic soils, primarily loamy sands, sandy loams and silty/clay loams. Canopy dominated by a mixture of oaks (<i>Quercus alba</i>, <i>Q. falcata</i> &amp; <i>Q. velutina</i>). Characteristic understory species of this association are <i>Gaylussacia frondosa</i> &amp; <i>Pteridium aquilinum</i>. Other tree associates include <i>Sassafras albidum</i>, <i>Q. coccinea</i>, <i>Q. stellata</i>, <i>Liquidambar styraciflua</i>, <i>Nyssa sylvatica</i>, <i>Carya spp</i> &amp; <i>Pinus taeda</i>, <i>v. Acer rubrum</i>, <i>Ilex opaca</i> &amp; <i>Cornus florida</i> forming the subcanopy. The shrub layer is well-developed and dominated by members of heath family (<i>Gaylussacia [baccata &amp; pallidum]</i>, <i>Vaccinium spp</i>) and <i>Aralia spinosa</i>. The herbaceous layer is sparse with some <i>Cyrtopodium acaule</i>, <i>Chimaphila maculate</i> &amp; <i>Gaultheria procumbens</i>.</p> <p><b>Potential Focal Species: DFS, breeding Forest Interior Dwelling Birds, migrating and wintering landbirds.</b></p> <p><b><i>Prionus laticollis</i> (County Record = Long-Horned Beetles or Cerambycids not ranked in Delaware but species is considered an indicator species of mature healthy forest; 2 rare moths, <i>Catocala lacrymosa</i> &amp; <i>Papaipema aralia</i> (Host plant = <i>Hercules Club</i>).</b></p>	<p>Distribution in mid-Atlantic Coastal Plain is mainly 2<sup>nd</sup> growth successional forests following logging or agricultural cropping. Periodic fire is an important natural disturbance in this forest type &amp; encourages oak regeneration. The relative cover of <i>Pinus taeda</i> is related to disturbance history, w/ higher pine cover suggesting more recent disturbance from farming or logging.</p>	<p><b>Status: G4G5</b>  <b>DE: SNR.</b> This type of oak forest is uncommon in Delaware's state landscape &amp; mature examples are rare. All stands are vulnerable to fire suppression &amp; logging disturbances. State Reference Sites are Milford Neck and Prime Hook NWR; Protect invertebrate fauna from exposure to Naled and Dimilin applications when possible as these chemicals have adverse impacts on invertebrate communities.</p>

Habitat and Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Structure, Species Composition)	Natural Processes responsible for these conditions	Limiting Factors
<p><b>Mesic Coastal Plain Oak Forest (193 A)</b></p>	<p>This community is a mesic oak forest of the central Atlantic Coastal. On refuge, this community borders wetland habitats that have sandy soils w/ a high water table (wetter than previous community). Refuge areas have mesic to poorly drained soils &amp; the presence of willow Oak and Swamp Chestnut Oak distinguish this community from Southern Red Oak/Heath Forest community. Canopy dominants include <i>Quercus falcata</i>, <i>Q. phellos</i>, <i>Q. alba</i> &amp; <i>Acer rubrum</i>. <i>Pinus taeda</i>, <i>Q. michauxii</i>, <i>P. serotina</i>, <i>Q. nigra</i>, <i>Q. palustris</i> &amp; <i>Liquidambar styraciflua</i>. Subcanopy dominated by <i>Ilex opaca</i>, <i>Vaccinium corymbosum</i> &amp; <i>Amelanchier canadensis</i>. <i>Gaylussacia frondosa</i>, and <i>Leucothoe racemosa</i> forms a patchy shrub layer draped w/ <i>Smilax rotundifolia</i>. Herb layer is sparse w/ slender spikegrass (<i>Chasmanthium laxum</i>), royal fern (<i>Osmunda regalis</i>), partridge berry (<i>Mitchella repens</i>), Virginia cutgrass (<i>Leersia virginica</i>), stout wood weedgrass (<i>Cinna arundinacea</i>), and teaberry (<i>Gaultheria procumbens</i>).</p> <p>This forest community on the refuge is also known to support exceptionally large trees in “Gum Woods,” First and Second Hills and Oak Island sites that include the following examples: southern red oak (39 dbh), willow oak (53 dbh), pin oak ( 45 dbh), water oak (29 dbh), black walnut (24 dbh), and pond pine (30 dbh).</p>	<p>Poorly drained sand generally makes up the soil substrates for this community and a high water table is often present. This association grades into drier upland oak forests. State Reference Sites in Delaware include Milford Neck and Prime Hook NWR. Unique features on refuge of these forest patch-types support exceptionally large trees found in the County/State averaging 35 dbh inches (1<sup>st</sup> &amp; 2<sup>nd</sup> Hills) w/ largest tree 53 inch dbh (Willow Oak) on Oak Island.</p>	<p>This community typically occurs in a fragmented setting, so it is more prone to exotic species encroachment. On refuge, invasive species that out-compete native species include Japanese Stiltgrass, Multiflora Rose and M-A-M; High density of deer over-browsing understory, reducing diversity and hampering natural oak regeneration.</p>

Habitat and Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Structure, Species Composition)	Natural Processes responsible for these conditions	Limiting Factors
<p><b>Mid-Atlantic Coastal Plain Loblolly Pine Forest 51A</b></p>	<p>The physiognomy of this association varies from dense tall shrub thickets dominated by Wax-myrtle to salt-pruned loblolly trees. Canopy is dominated by <i>Pinus taeda</i>, w/ scattered <i>Q. falcata</i>, <i>Q. alba</i>, <i>Carya alba</i> &amp; <i>P. virginiana</i>. Shrub layer is well-developed where canopy is more open, dominated by <i>Ilex opaca</i>, <i>Cornus florida</i>, <i>Aralia spinosa</i> <i>Sassafras albidum</i> &amp; <i>Magnolia virginiana</i>. Vines are always present, dominated by <i>Vitis aestivalis</i>. Herbaceous layer dominants include <i>Chasmanthium lacuum</i>, <i>Panicum virgatum</i>, <i>Eupatorium hyssopifolium</i>, <i>Cyripedium acaule</i>, <i>Mitchella repens</i>, and <i>Parthenocissus quinquefolia</i>.</p> <p><b>Potential Focal Species: DFS, breeding and migrating landbird species and <i>Photuris frontalis</i>, <i>Zale metatoides</i>, and <i>Z. metata</i>; use rare invertebrate fauna as possible indicators of environmental health.</b></p>	<p>Maritime community occurs on sand dunes, upper edges of coastal marsh areas. The substrate is rapidly moist sands or sandy loams which are nutrient poor.</p>	<p>This coastal community is limited to the mid-Atlantic states of DE, MD, VA &amp; NC. These forests are restricted to a narrow geographic range and are very vulnerable to development pressure, degradation from intensive ag practices, and recreational use demands. Ranked <b>G3</b> mostly because of bayberry shrub component (<i>Morella spp.</i>), this community is under represented across state and regional landscapes.</p>
<p><b>Northern Coastal Plain Basic Mesic Hardwood Forest 35 A</b></p>	<p>Tuliptree rich woods are associated with loamy soils dominated by <i>Liriodendron tulipifera</i>, plus <i>Carya glabra</i>. <i>Liquidambar styraciflua</i>, <i>Circaea lutetiana</i> &amp; <i>Cornus florida</i> are co-dominants in the subcanopy. Shrub layer dominated by <i>Viburnum prunifolium</i>, <i>Lindera benzoin</i>. Herb layer is diverse and includes a number of species restricted to this forest type on the Coastal Plain. Indicator species include <i>Botrychium biternatum</i> and <i>B. dissectum</i>. Unique herbaceous vine (Canada Moonseed) <i>Menispermum canadense</i> is found here plus rare climbing vine <i>Passiflora lutea</i> (S3-yellow passion flower) Herbaceous species include <i>Asplenium platyneuron</i>, <i>Circaea lutetiana</i>, <i>Senecio tomentosus</i> and the rare (S3- green fringe orchis) <i>Platanthera lacera</i>.</p>	<p>Development of this community type is associated with rich loamy soils, high in nutrients with a mid-range pH. Natural disturbance of periodic fire encourages oak regeneration &amp; enriches herbaceous diversity. Community is typified by a prevalence of tuliptree in the canopy. Community is locally rare in Sussex County.</p>	<p>Fragmentation due to historic logging and agricultural practices. Encroachment by invasives such as Japanese stiltgrass, multiflora rose &amp; honeysuckle can degrade the ground story and shrub layers of this community. Protect inverts from Mosquito drift of Adulticides &amp; Dimilin applications. Protect from over abundant deer populations and excessive browsing.</p>

Habitat and Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Structure, Species Composition)	Natural Processes responsible for these conditions	Limiting Factors
<p><b>Mid-Atlantic Mesic Coastal Plain Mixed Hardwood Forest 19 A</b></p>	<p>This community is distinguished by a mixture of deciduous hardwood especially of tuliptree, American beech, and oaks. It is a mixed mesophytic forest dominated by <i>Quercus alba</i>, <i>Q. rubra</i>, &amp; <i>Liriodendron tulipifera</i> with <i>Fagus grandifolia</i> <i>Carya</i> spp as associates; Understory dominated by highbush blueberry (<i>Vaccinium corymbosum</i>), lowbush blueberry (<i>V. pallidum</i>), and American holly (<i>Ilex opaca</i>). Herb layer includes pink lady's-slipper (<i>Cypripedium acaule</i>), partridge-berry (<i>Mitchella repens</i>), cranefly orchid (<i>Tipularia discolor</i>), downy rattlesnake-plantain (<i>Goodyera pubescens</i>), Swan's sedge (<i>Carex swanii</i>), and common Solomon's-seal (<i>Polygonatum biflorum</i>).</p>	<p>This community often develops where soils are moist. Forest community type usually found on soils that moderately drained, and characterized by acidic, sandy and silt loams derived from parent material of low to moderate fertility. Maintenance of closed-canopy conditions best to sustain forest structure and composition.</p>	<p>Fragmentation due to logging &amp; agricultural practices. On refuge fragmented landscape setting is prone to invasion by exotic species, esp. multiflora rose, mile-a-minute weed, and Japanese stiltgrass. Habitat type is also rapidly disappearing at County &amp; State Level due to development. Manage deer populations to prevent excessive overbrowsing.</p>
<p><b>Successional Sweetgum Forest 154 A; Mid-Atlantic to Late Successional Loblolly Pine-Sweetgum Forest 24A; Red Maple:Sweetgum Forest 3A</b></p>	<p>These communities result from succession following human activities of timber harvesting and clearing for agriculture. Stands are either dominated by <i>Liquidambar styraciflora</i>, sometimes to the exclusion of other species or stands are codominated by <i>Pinus taeda</i>, <i>P.virginiana</i> &amp; <i>Acer rubrum</i>. Understory composition differ based on edaphic site factors (ranging from mesic to dry on a wide variety of generally acidic soils). A portion of successional sweetgum forest (SE of Hdqrts) contains an open, early successional grassland-like habitat within the sweetgum forest. The state rare plant lance-leaf orange milkweed (S-1)-<i>Asclepis lanceolata</i>; This population contains over 100 individuals and is the largest known population of this species on the Delmarva Peninsula.</p>	<p>These associations are found on uplands that have been heavily impacted by agriculture or other severe disturbances and are recovering. As the stands of <i>L. styraciflora</i> mature, they begin to assume the characteristics of more natural community types. Over time, sweetgum declines and is replaced by oaks, hickories, and/or pines.</p>	<p>Exotic encroachment of Lespedeza, Multiflora rose and Japanese Stiltgrass; Habitat containing rare milkweed also contains well-established reed canary grass (<i>Phalaris arundinacea</i>).</p>

Habitat and Plant Communities that Represent Existing BIDEH	Population/Habitat Attributes (Structure, Species Composition)	Natural Processes responsible for these conditions	Limiting Factors
<p><b>Pond Pine Woodland (7.5A) Pond Pine Sweetbay Highbush Blueberry/ Prickly Bog Sedge Association</b></p>	<p>A diagnostic feature of this community is pond pine as the main canopy species with an understory of red maples. This association is located around Flaxhole Pond in Unit III. Although <i>Pinus serotina</i> can be found in a few other locations in Delaware, the refuge location is the only site where there is a well-developed community in the state. This community is open and dominated by <i>Pinus serotina</i>. The understory has red maple (<i>Acer rubrum</i>), sweetgum (<i>L. styraciflua</i>), and sweetbay magnolia (<i>Magnolia virginiana</i>). The shrub layer is dense and dominated by highbush blueberry (<i>Vaccinium corymbosum</i>), red chokeberry (<i>Photinia pyrifolia</i>). Other shrub layer associates include <i>Leucothoe racemosa</i>, <i>Itea virginica</i>, <i>Clethra alnifolia</i>. The uncommon Walter's greenbrier (S3) (<i>Smilax walteri</i>) occupies the vine layer. Common herbs include <i>Carex atlantica</i>, <i>C. lurida</i>, <i>Woodwardia virginica</i>, <i>Osmunda regalis</i>, and <i>Sagittaria latifolia</i>.</p>	<p>This community is located in saturated soils, often with standing water. Fire may have been an important ecological force in shaping this community which occurs in seasonally flooded shallow basins. Substrates are acidic, gleyed to mottled sandy or clay loams that develop in standing water for part of the year.</p>	<p>Fire suppression, invasive plant species encroachment and agricultural runoff causing eutrophication.</p>

Table D-3. Summary of Biological Integrity, Diversity, and Environmental Health (BIDEH) Elements for Prime Hook National Wildlife Refuge  
**III. FORESTED WETLAND HABITATS - 1,237 ACRES 4/3/2012**

Habitats (Plant Communities that Represent existing BIDEH)	Population/Habitat Attributes (Structure & Species Composition)	Natural Processes Responsible for these conditions.	Limiting Factors
<p><b>Red Maple Seaside Alder Swamp 799 A</b></p>	<p>This community is a low-growing, partially open to open saturated woodland basin swamp bordering a 7-mile freshwater non-tidal creek (Prime Hook Creek). It is mostly dominated by <i>Acer rubrum</i>. The understory along creekside edges is dominated by <i>Alnus maritima</i>, <i>Decodon verticillatus</i>, <i>Clethra alnifolia</i>, <i>Morella cerifera</i>, <i>Cephalanthus occidentalis</i>, and <i>Leucothoe racemosa</i> occur as associates in the shrub layer. Herbaceous layer includes Water's St John's wort (<i>Triadenum walteri</i>), cardinal flower (<i>Lobelia cardinalis</i>) weak stellate sedge (<i>Carex scorsa</i>) three-way sedge (<i>Dulichium arundinaceum</i>) royal fern (<i>Osmunda regalis</i>), and mild water-pepper (<i>Polygonum hydropiperoides</i>) plus rare plants listed below.</p> <p><b>Potential Focal Species = Birds: Kentucky Warbler, Prothonotary Warbler, Yellow-throated Vireo, Chimney Swift, Acadian Flycatcher, Cerulean Warbler (SEN), Swainson's Warbler (SEN), migrating and wintering landbirds.</b></p> <p><b>Potential Indicator Species: Carpenter Frog (S1), Cope's Gray Tree frog (S1), Ribbon Snake (S1), Rough Green Snake (S2), Sphinx Moth (SIS3), Great Purple Hairstreak (S1), Delaware Skipper &amp; <i>Catocala praectara</i>.</b></p> <p><b>Rare Plants: green fringe orchis (<i>Platanthera lacera-S3</i>), seaside alder <i>Alnus maritima (S3)</i>, and gibbous grass <i>Sacciolepis striata (S2)</i>.</b></p>	<p>Most of the substrate is saturated peat and muck characterized by hummock-and-hollow microtopography. Prime Hook Creek was historically tidally influenced up until 1983 when PHC became enclosed w/in a 2,500 freshwater impoundment. Maintenance and survival of this community may be dependent on artificial hydrological conditions created within a closed non-tidal freshwater impounded ecosystem.</p>	<p>This community may be successional due to water level management and impoundment infrastructure. Occasional storm surges may also influence community composition. <i>Phragmites</i> encroachment also a problem.</p>

Habitats (Plant Communities that Represent existing BIDEH)	Population/Habitat Attributes (Structure & Species Composition)	Natural Processes Responsible for these conditions.	Limiting Factors
<p><b>Coastal Plain Depression Swamp (New Name = RedMaple/ Sweetgum Swamp)</b> 335 A</p>	<p>Signature trees of this community include <i>Acer rubrum</i>, <i>Liquidambar styraciflua</i>, <i>Quercus phellos</i>, <i>Nyssa sylvatica</i> &amp; <i>Prunus serotina</i>. Other associates include <i>Nyssa biflora</i>, <i>Magnolia virginiana</i>, <i>Ilex opaca</i> &amp; <i>Pinus taeda</i>. Shrub layer is characterized by <i>Leucothoe racemosa</i>, <i>Vaccinium corymbosum</i>, <i>Clethra alnifolia</i>, <i>Ilex verticillata</i> &amp; <i>Rhododendron viscosum</i>. Common herbs include royal fern (<i>Osmunda regalis</i>), New York fern (<i>Thelypteris noveboracensis</i>), and netted chain fern (<i>Woodwardia areolata</i>). State rare plants include cattail sedge [<i>Carex typhina</i> (S3)], and blue-flag iris [<i>Iris prismatica</i> (S3)].</p> <p>Potential Focal Species include breeding populations of Kentucky warbler, Prothonotary warbler, yellow-throated warbler, Acadian flycatcher, and migrating and wintering landbirds.</p> <p>Rare invertebrates, reptiles and amphibians same as found in red maple/seaside alder swamp association.</p>	<p>This association is a seasonally flooded forest of shallow basins or depressions of the Coastal Plain of the Delaware Bay. Periodic flooding of depressions result in substrates that are acidic, gleyed to mottled, sandy or clay loams with a very high water table. <b>Note:</b> Coastal Plain Ponds, (also known as Carolina or Delmarva Bays) are unique, isolated non-tidal freshwater wetlands w/in a forested area. Three were inventoried on the refuge (Buttonbush &amp; Swamp Cottonwood Coastal Plain Ponds and a 3<sup>rd</sup> community yet to be named, clumped in Coastal Plain Depression Swamp association.</p>	<p>Invasive Exotics like M-A-M &amp; <i>Phragmites</i>; Alteration and drying by drainage ditching for farming and mosquito control activities; Negative impacts of drift of Dimilin or Adulticides are lethal to rare and common invertebrate species.</p>

Habitats (Plant Communities that Represent existing BIDEH)	Population/Habitat Attributes (Structure & Species Composition)	Natural Processes Responsible for these conditions.	Limiting Factors
<p><b>Coastal Loblolly Pine Wetland Forest</b> 91A</p>	<p>Refuge association is Loblolly Pine/Wax Myrtle/ Royal Fern Forest with a closed to partially open canopy dominated by <i>Pinus taeda</i> associated with <i>Acer rubrum</i> and/or <i>Liquidambar styraciflua</i>. Understory species include <i>Nyssa sylvatica</i>, <i>Ilex opaca</i>, <i>Magnolia virginica</i>, <i>Morella cerifera</i> &amp; <i>Smilax walteri</i> (S3). Soils are characterized by moderately shallow muck (15 cm) overlying organic matter-stained sands. Herbs are sparse with <i>Woodwardia areolata</i> &amp; <i>W. virginica</i> and the rare (S3) <i>Listera australis</i> (southern twayblade) as main plant species on forest floor.</p> <p>All forested wetland communities listed are extremely important to both short-distance and long-distance migratory and wintering landbird species.</p>	<p>Maritime coastal wetland forest areas occur in back dune depressions with high water tables and along fringes of estuaries from Delaware to NC. Fire may once have been an important ecological force in this community.</p>	<p>Development pressures and encroachment of exotic invasive species.</p>
<p><b>Atlantic White-Cedar Seaside Alder Swamp</b> 10 A</p>	<p>The tree canopy is characterized by low-stature (&lt;30 m) <i>Chamaecyparis thuyoides</i> in association with <i>Alnus maritima</i> as an understory species on community edges adjacent to open water; as well as in canopy gaps. Other woody associates include <i>Morella cerifera</i>, <i>Ilex glabra</i>, <i>Clethra alnifolia</i>, &amp; <i>Alnus serrulata</i>. The herbaceous layer is very diverse, comprised of <i>Decodon verticillatus</i>, <i>Peltandra virginica</i>, <i>Nymphophaea odorata</i>, <i>Glyceria obtuse</i>, <i>Carex atlantica</i> and several rare plants: S1 <i>Eriocaulon decangulare</i>, S2 <i>Drosera rotundifolia</i>, S2 <i>Juncus militaris</i>. Developed floating mats w/in this swamp association have unique and rare species assemblage including <i>Xyris difformis</i>, <i>Juncus canadensis</i>, <i>Fimbristylis autumnalis</i>, <i>Fuirena pumila</i> S3, <i>F. squarrosa</i> S2, <i>Juncus pelocarpus</i> S2, <i>Rhynchospora alba</i> S2, <i>R. scirpoides</i> S2, <i>Eriocaulon compressum</i> S2, <i>Pogonia ophioglossoides</i> S2, and the extremely rare coast sedge, S1-<i>Carex evilis</i>.</p> <p><b>Potential Focal Species:</b> Carpenter Frog, Cope's Gray Treefrog, Ribbon Snake, Rough Green Snake</p>	<p>This open-canopy Atlantic white-cedar swamp occurs along streams of the Delmarva Peninsula. It is found along PHC area w/in Unit III 2,500 acre impounded freshwater marsh. These communities were once cedar-swamp streams now filling in with peat substrate, herbs and Seaside Alder; may be of artificial origin due to impounding the area since 1983.</p>	<p>Habitat Loss &amp; Fragmentation; Encroachment of Invasive Species; This community is known to require fire in order to regenerate; Periodic Rx burns may help make community more robust, but adequate precautions must be taken to protect extant rare faunal species.</p>

Habitats (Plant Communities that Represent existing BIDEH)	Population/Habitat Attributes (Structure & Species Composition)	Natural Processes Responsible for these conditions.	Limiting Factors
<p><b>Swamp Cottonwood Coastal Plain Pond (2 A)</b></p>	<p>This community is a small isolated non-tidal freshwater wetland developing in a depression dominated by <i>Populus heterophylla</i> &amp; <i>Decodon verticillatus</i>. It is codominated by <i>Acre rubrum</i>, <i>Quercus palustris</i>, and <i>Liquidambar styraciflua</i>. Few species in the understory, mostly <i>A. rubrum</i> &amp; <i>Fragaria pennsylvanica</i> seedlings and <i>Clethra alnifolia</i>. Herbaceous layer is dominated by <i>Microstegium vimineum</i> &amp; <i>Polygonum hydropiperoides</i>.</p> <p><b>Potential Focal Species: <i>Catocala marorata</i> (S1, G3); Both state &amp; globally rare; host plant = Swamp Cottonwood, highlighting extremely important interaction between this plant &amp; Marbled Underwing Moth.</b></p>	<p>This community occupies shallow depressions that fill with water in the late fall and winter and then dry in the summer.</p>	<p>Japanese stilt grass invasive and agricultural runoff (pesticides, nitrates &amp; phosphates) have contributed to degrading this community; Excessive Beaver damage to Cottonwood trees.</p>

Table D-4. Summary of Biological Integrity, Diversity, and Environmental Health Elements for Prime Hook National Wildlife Refuge  
 IV. WETLAND HABITATS – 6,456 Acres 4/3/2012

Habitats (Plant Communities that Represent Existing BIDEH)	Population/Habitat Attributes (Structure & Species Composition)	Natural Processes Responsible for these conditions	Limiting Factors
Emergent Wetlands/Moist-soil Impoundments (2946 A)/ Water (1554 A)	<p>Wild Rice Freshwater Marsh <i>Zizania aquatica</i>, co-dominant w/ arrow-arum (<i>Peltandra virginica</i>), halbeard-leaf tearthumb (<i>Polygonum arifolium</i>) mild water pepper (<i>P. hydropiperoides</i>), and seasonal annual moist soil plants like barnyard grass (<i>Echinochloa walteri</i>), beggarticks (<i>Bidens laevis</i>), spike rushes (<i>Eleocharis spp.</i>), fall panicum grass (<i>Panicum dichlororomiflorum</i>), etc. Additional associates include <i>Leersia oryzoides</i>, <i>Amaranthus cannabinus</i>, <i>Typha angustifolia</i>, <i>T. latifolia</i>, <i>Impatiens capensis</i>, <i>P. sagittatum</i>, <i>P. punctatum</i>. Small patches of rare (S1-S3) plant populations and other vascular plants are scattered throughout impounded emergent wetlands demonstrating considerable native plant diversity. Some examples include:</p> <ul style="list-style-type: none"> <li>• swamp sunflower (<i>Helianthus angustifolius</i>)</li> <li>• sea purslane (<i>Sesuvium maritimum</i>)</li> <li>• hemlock water-parsnip (<i>Sium suave</i>)</li> <li>• Canada richweed (<i>Pilea pumila</i>)</li> <li>• sweetflag (<i>Acorus calamus</i>)</li> </ul> <p>Diverse native plant communities also support diverse invertebrate species associated with specific plant communities.</p>	<p>This habitat cover type is a composite of several smaller perennial plant communities, surrounded by annual moist-soil plants that are continually in flux due to dynamic hydrology, created by water level management and seasonal manipulations, climatic and seasonal storm severities.</p>	<p>Exotic plant invasions, especially <i>Phragmites</i> and <i>Ludwigia leptocarpa</i>;                      Water quality issues due to eutrophication both from on-refuge and off-refuge sources, Mercury contamination of wetlands through atmospheric deposition; Ground-water depletion due to large commercial irrigation systems adjacent to refuge lands; Invertebrate communities should be protected from Adulticide applications.</p>
	<p><b>Potential Focal Species:</b> Migrating &amp; wintering Ducks; migrant CAGOs (spring &amp; fall); 6 key perennial vegetation communities support the Bronze Copper (<i>Lycaena hyllus</i>). This species is declining in the Delaware Estuary and the refuge is maintaining best state occurrences w/in its impounded marshes in the state; also true for <i>Photuris pensylvanica</i> firefly, <i>Lycaena hyllus</i> (S1), and <i>Ischnura kellicotti</i> (S2).</p>		

Habitats (Plant Communities that Represent Existing BIDEH)	Population/Habitat Attributes (Structure & Species Composition)	Natural Processes Responsible for these conditions	Limiting Factors
<p><b>Coastal Plain Ponds (Freshwater Depressional Ponds) ( 10-A)</b></p>	<p>These are non-tidal, isolated, freshwater depressional wetlands with substrates that are a deep muck, with some areas of mucky sand and sand. Characteristic vegetation includes fragrant waterlily (<i>Nymphaea odorata</i>), watershield (<i>Brasenia schreberi</i>) seedboxes (<i>Ludwigia spp.</i>), and bladderworts (<i>Utricularia spp.</i>). Depressional Ponds also provide habitat for several state-rare plants:</p> <ul style="list-style-type: none"> <li>• Robbin's spikerush (S3) <i>Eleocharis robbinsii</i></li> <li>• Cattail sedge (S3) <i>Carex typhina</i></li> <li>• Slender blue-flag iris (S3) <i>Iris primatica</i></li> </ul>	<p>Hydromorphic coastal pond plain community is limited to the Atlantic Coastal Plain from southern New England to Maryland. These wetlands are important ground-water recharge areas.</p>	<p>Global Ranking G2. In Delaware, Heritage scientists rank this community for protection, as it is increasing rare in the state due to the fact that coastal plain ponds are not legally regulated; Also ponds are vulnerable to destruction via ditching, draining, filling and agricultural runoff causing eutrophication. They are also threatened by hydrologic alteration (groundwater depletion).</p>

Habitats (Plant Communities that Represent Existing BIDEH)	Population/Habitat Attributes (Structure & Species Composition)	Natural Processes Responsible for these conditions	Limiting Factors
<p>Peat-Mat (Bog) Communities (10 A)  <b>DNHP:→ Most significant community-type found on refuge with respect to flora and faunal diversity.</b></p>	<p>The refuge contains several examples of Twig Rush/Ten-Angle Pipewort/Tawny Cotton Grass Herbaceous Veg: which are the most floristically diverse habitat on the refuge and in the state with 66 species and varieties documented, supporting 24 state-rare plant species (See HMP Appendix ? for comprehensive plant list). <i>Cladium mariscoides</i> is dominant herb. Associated herbaceous plants include (S1) <i>Eriocaulon decangulare</i> &amp; (S1) <i>Eriophorum virginicum</i> <i>Bidens coronata</i>, <i>B. mitis</i>, <i>Sagittaria engelmanniana</i>, <i>Rhynchospora alba</i>, <i>Spiranthes cernua</i>, <i>Eleocharis robbinsii</i> &amp; <i>Bartonia paniculata</i>. Scattered shrubs include <i>Smilax walteri</i>, <i>Clethra alnifolia</i>, <i>S. laurifolia</i> &amp; <i>Alnus maritima</i>.</p> <p>In addition, a subspecies new to the flora of Delaware and Delmarva Peninsula was discovered here: Bushy Bluestem [<i>Andropogon glomeratus</i> var.<i>hirsutior</i> (S1)].</p> <p>Rare Fauna associated with flora include:</p> <ul style="list-style-type: none"> <li>• Elfin skimmer [S1] (<i>Nannothemis bella</i>)</li> <li>• Lilypad forktail [S1] (<i>Ischnura kellicotti</i>)</li> <li>• Sphagnum Sprite [S1] (<i>Nehalennia gracilis</i>)</li> <li>• Several firefly species (<i>Photuris pyralomimus</i>, <i>tremulans</i>, and <i>frontalis</i>)</li> <li>• New leafhopper species Delphacidae, <i>Megamelus species</i> currently being described.</li> </ul> <p>Potential Focal Species: <i>Nannothemis bella</i> (S1), <i>Sphagnum Sprite</i> (S1), <i>Photuris pensylvanica</i> (S2), <i>P. tremulans</i> (s1), <i>Xestia youngii</i> (S1) &amp; <i>Exyra fax</i> (S1).</p>	<p>Unique and rare community type that occurs on deep, mucky peat that forms in open-water depressions within impounded marsh, and/or seeps within a shrub dominated swamp matrix. Natural succession from open water to peatland to forested wetland. Early successional versions have thinner peat layers and less species-richness. Peat mosses documented here include <i>Sphagnum fimbriatum</i>, <i>S. recurvum</i>, &amp; <i>S. perichaetile</i>.</p>	<p>These sites support many state (DE) and globally rare plant species, associated rare invertebrates and are also valuable in supporting rare amphibian species that are found here. To maintain this habitat for rare plants and animals, active management of woody vegetation and control of non-native invasives encroaching along the perimeter as well as in the interior of these peat-mat communities is recommended (DNHP 2007).</p>

Habitats (Plant Communities that Represent Existing BIDEH)	Population/Habitat Attributes (Structure & Species Composition)	Natural Processes Responsible for these conditions	Limiting Factors
<p><b>Wax-Myrtle Shrub Swamps (67 A)</b></p>	<p>Shrub canopy is relatively open to moderately dense and dominated by <i>Morella cerifera</i>, <i>Baccharis halimifolia</i>. Herbaceous layer diverse &amp; characterized by <i>Eleocharis</i> spp., <i>Kosteletzkya virginica</i>, <i>Hibiscus moscheutos</i>, <i>Typha angustifolia</i>, <i>Polygonum punctatum</i>, <i>Pluchea odorata</i>, <i>Spatina patens</i>, <i>Asclepias incarnate</i>, <i>Ptilimnium capillaceum</i>, <i>Cyperus filicinus</i>, <i>Panicum virgatum</i>, <i>Schoenoplectus americanus</i>, <i>Amaranthus cannabinus</i>.  <b>Potential Focal Species: <i>Catocala muliercula</i> by securing health of host plant = <i>Morella cerifera</i>.</b></p>	<p>Oligohaline (0-5 ppt) shrubland of fresh to brackish waters on firm, partially decomposed peat lacking pronounced hummock and hollow micro-topography. This vegetation forms linear stands along waterways between freshwater marshes and adjacent swamp forests.</p>	<p>Habitat Degradation &amp; Loss; Invasive species encroachment, mostly M-A-M &amp; <i>Phragmites</i>. <i>Morella</i> spp. Rare in state landscape &amp; serves as host plant for rare inverts.</p>
<p><b>Water Willow Shrub Swamp (2A)</b></p>	<p>Community dominated by broad-leaved deciduous shrub, <i>Decodon verticillatus</i>. These communities are in association w/ Peat-bog mats. <i>D. verticillatus</i> forms a dense, often monotypic stand. <i>Cephalanthus occidentalis</i> also occurs but with less abundance that water willow. Herbaceous species vary widely to include <i>Nuphar advena</i>, <i>Nymphophea odorata</i>, <i>Peltandra virginica</i>, <i>Pontedericia cordata</i>, <i>Utricularia</i> spp. &amp; <i>Potamogeton</i> spp.</p>	<p>This shrub border occurs as a fringe along PH Creek and other refuge freshwater waterways. Most often <i>Decodon verticillatus</i> will form a dense tangle bordering this creek.</p>	<p>Major limiting factor would be salt-water intrusion; Invasive species encroachment.</p>
<p><b>Buttonbush Coastal Pond Plain (1 A)</b></p>	<p>Substrate is a shallow organic layer overlying silt loam or clay loam. Diagnostic features are <i>Cephalanthus occidentalis</i> as dominant shrub w/ the moss <i>Fontinalis</i> spp., draped on limbs. Characteristic herbs = <i>Polygonum hydropiperoides</i>, <i>Dulichium arundinaceum</i>, <i>Bidens frondosa</i>, <i>Scirpus cyperinus</i>, <i>Fimbristylis autumnalis</i>, <i>Carex lurida</i>, <i>Panicum dichotomiflorum</i>, and <i>P. amphibium</i>.</p>	<p>Small basin wetlands that drawdown entirely during dry years; most of the Coastal Plain ponds are sinkhole features that formed through dissolution of underlying carbonate-rich shell marl deposits.</p>	<p>Globally Ranked as (G3); Few occurrences in mid-Atlantic region as acreage is very small; community is threatened by groundwater alteration &amp; agricultural runoff &amp; drainage ditches.</p>

Habitats (Plant Communities that Represent Existing BIDEH)	Population/Habitat Attributes (Structure & Species Composition)	Natural Processes Responsible for these conditions	Limiting Factors
<p><b>Irregularly Flooded Eastern Tidal Salt Shrub (96 A)</b></p>	<p>This shrubland occurs in patches above mean high tide and can be flooded by storm tides. Substrate is peat over sand, or sandy loam. Dominated by <i>Iva frutescens</i> &amp; <i>Baccharis halimifolia</i>. Also associated w/ <i>Morella cerifera</i> &amp; <i>Juniperus virginiana</i>. Herbaceous layer dominated by <i>S. patens</i>; other herbaceous associates include <i>Distichlis spicata</i>, <i>Hibiscus moscheutos</i>, <i>Teucrium canadense</i>, <i>Toxicodendron radicans</i>, <i>Cuscuta gronovii</i> &amp; <i>Solidago sempervirens</i>.</p> <p>Potential Focal Species for Tidal Creek Shrubland/ Spartina High &amp; Low Salt Marsh: Saltmarsh Sharp-tailed sparrow, Black Rail (SEN), Prairie Warbler, Seaside Sparrow, ABDU, Willet, Clapper Rail, Short-eared Owl, Henslow's Sparrow (SEN), Sedge Wren, Coastal Plain Swamp Sparrow.</p>	<p>Maritime/estuarine shrubland of the mid-Atlantic occurring in association with salt marshes. It forms an ecotone between high marsh and adjacent upland vegetation. Seaward, this association grades into high salt marsh dominated by herbaceous vegetation, but landward, shrub cover becomes more dense. This community is differentiated from the Wax-Myrtle Shrub Swamp of <i>Morella cerifera/Baccharis halimifolia/Spartina spp</i> by the presence of <i>Iva frutescens</i> and higher salinity regimes, characteristic of diurnal to irregularly flooded mesohaline (5.0 – 18.0 ppt) areas bordering Broadkill River and Slaughter Canal.</p>	<p>Heavy salt spray and tidal flooding from severe storms can cause die-back in the shrub layer; <i>Phragmites</i> encroachment.</p>

Habitats (Plant Communities that Represent Existing BIDEH)	Population/Habitat Attributes (Structure & Species Composition)	Natural Processes Responsible for these conditions	Limiting Factors
<p><b>North Atlantic High Marsh (85 A)</b></p>	<p>High Salt Marsh is dominated by <i>Spartina patens</i> &amp; codominated by <i>Distichlis spicata</i> &amp; <i>Juncus gerardii</i>. Other associates in low density include <i>Aster tenuifolius</i>, <i>A. subulatus</i>, <i>Atriplex patula</i>, <i>Solidago sempervirens</i> &amp; <i>Panicum virgatum</i>. Salt panes are a prominent feature within this association. This community occupies zones extending from mean high tide landward to the limit of spring tides.</p> <p>Potential target Rocs include American Black Duck, breeding salt marsh passerines species, black rail, and willet, migrating and wintering waterfowl and waterbirds.</p>	<p>Vegetation occurs as a shifting mosaic of patches dominated by a single grass species dictated by hydroperiod, nutrient availability, salinity gradients, soil oxygen and interspecific competition.</p> <p>As sedimentation increases marsh elevation, vegetation shifts to upland border communities dominated by <i>Panicum virgatum</i> &amp; <i>Juncus gerardii</i>. Local disturbance from ice scouring or extensive snow goose herbivory can cause invasion by <i>S. alterniflora</i>, or can lead to the formation of salt panes.</p>	<p>Diking and draining; OMWM excavations; altered hydrology; invasive species; sea level rise; mercury contamination and salt marsh die-back.</p>

Habitats (Plant Communities that Represent Existing BIDEH)	Population/Habitat Attributes (Structure & Species Composition)	Natural Processes Responsible for these conditions	Limiting Factors
<p>North Atlantic Low Salt Marsh (1685 A)</p>	<p>Tall grassland dominated by <i>S. alterniflora</i> forms a coarse peat over mucky silt to silty coarse fibrous peat with high organic matter content. Occurs in regularly flooded intertidal zone (from mean high tide to mean sea level; diurnally flooded by polyhaline (18-30 ppt) tides; tall-form alterniflora occurs nearest tidal waterways and grades into short-form, landward, where tidal range is restricted. Common associates in low density include <i>Distichlis spicata</i>, <i>Salicornia maritima</i>, <i>Juncus gerardii</i> &amp; <i>J. roemerianus</i>, microscopic algae (esp. diatoms) are abundant on marsh surface.</p>	<p>Highly dynamic habitats; <i>Alterniflora</i> readily colonizes soft sediments off the seaward edge of the salt marsh. Grass culms and algal mats trap sediments brought in by tides. Peat development raises marsh elevation &amp; low marsh succeeds to high marsh.</p>	<p>“Salt-Marsh Die-Back”; Tidal Ranges of less than 1 meter; altered hydrology; Invasive Species; Mercury Contamination.</p>

Appendix D-5. Habitat Priorities at Prime Hook National Wildlife Refuge

Habitat Type	Reasons for Ranking	Limiting Factors/Threats
<b>PRIORITY I HABITATS</b>		
<b>I. Barrier Island Beach and Salt Marsh Habitats</b>		
Overwash Dunes	Presence of federally-listed species during migrational periods; Presence of nesting state-listed species; Importance to spring & fall migrating shorebirds and wading birds, including highest priority BCR 30 & MANEM species; Habitat type ranked S2/S3 & G2/G3; <b>Target Rocs*: American Oystercatcher, Red Knot, Sanderling, Whimbrel, Beach Dune Tiger Beetle, Horseshoe Crabs.* (See Note at Table's End)</b>	Human activities such as dune stabilization, ATV use; Running dogs and walking humans during nesting and critical migrational seasons; Loss of natural beach dynamics; Shoreline Protection Practices (Beach Replenishment & Artificial Dune Construction); Accidental spills of toxins and sewage; Invasive plants.
Dune Grassland	Maritime vegetation community supports uncommon state plants and rare invertebrate species; Ranked Globally as G2 and state ranked as <b>"Key Wildlife Habitat of Concern."</b> <b>Target Roc: Beach Dune Tiger Beetle.</b>	Artificial dune construction, trampling & ATV traffic; Adulticide Mosquito Chemical Use; Sea Level Rise and Climate Change; Invasive species.
Atlantic Coastal Interdune Swale	Uncommon plants including <i>Morella cerifera</i> canopy & herbaceous layer; Rare & unique invertebrate fauna absent from other state sites. <b>Target Rocs: Migratory landbirds in spring &amp; fall and rare inverts; Only 2 State Reference site in Delaware of this habitat type: 1) PHNWR &amp; 2) Great Marsh in Lewes.</b>	Habitat Loss and Fragmentation; Residential & Commercial Development; Adulticide Mosquito Chemical Use.
Maritime Red Cedar Woodland	Coastal Dune Community rare in Delaware (S1) w/ patches <b>Key Wildlife Habitat of Conservation Concern</b> of Ancient Sand Ridge Forest; Many rare S1 invertebrates dependent on vegetation within this community; Globally Ranked (G2).	Invasive plant species; Artificial dune stabilization; Residential/Commercial Development; Chemical applications of Dimilin & Mosquito Adulticides.
Salt Marsh <ul style="list-style-type: none"> <li>• North Atlantic High Marsh</li> <li>• North Atlantic Low Marsh</li> <li>• Irregularly Flooded Eastern Tidal Salt Shrub</li> <li>• Salt Panne</li> </ul>	Listed as a Habitat Of Conservation Concern in DWAP & refuge community harbors several bird species of state's greatest conservation need. <b>Target Rocs: Black rail, sharp-tail and seaside sparrows, coastal plain swamp sparrow, American black duck, gull-billed tern, common tern, black skimmer, least tern, Forster's tern, whimbrel and willet.</b> Black rails, Least & Forster's terns & Black skimmers are listed as state endangered species. Salt marsh sharp-tailed & seaside sparrows, American black duck, gull-billed & rosette terns are all listed as Tier 1 state birds (DWAP-2005).*	Altered hydrology due to OMWM excavations; Pesticides; Invasive species; Mercury contamination; Salt Marsh Die-Back; Climate Change; Sea Level Rise.

Habitat Type	Reasons for Ranking	Limiting Factors/Threats
<b>PRIORITY I HABITATS (cont.)</b>		
<b>II. Forested Uplands (Priority NVCS Associations)</b>		
Southern Red Oak Forest; Mid-Atlantic Coastal Plain Loblolly Pine Forest; Mesic Coastal Plain Oak Forest; Mid-Atlantic Mesic Mixed Hardwood Forest; Pond Pine Woodland; Northern Coastal Plain Basic Mesic Hardwood Forest.	Delaware Wildlife Action Plan (2005) has designated any forested Upland Blocks > 250 acres as <b>Key Wildlife Habitat of Conservation Concern</b> due to rarity of large contiguous forested blocks in state; <b>Target Rocs:</b> Delmarva fox squirrel, Bald Eagle, Breeding Landbirds, especially Wood thrush, Bay-breasted warbler; Black and white warbler; Great Crested Flycatcher; Kentucky warbler; Northern flicker; Scarlet Tanager; Whip-Poor-Will; Yellow-throated Vireo; Migrating Landbirds.	Major Habitat Loss of Forested Upland Habitats (> 75%) in state and Habitat Fragmentation due to clear cutting for development, & agricultural practices; Fire Suppression; Invasive plant species; Agricultural runoff & residential areas creating elevated levels of Nitrogen, Phosphorus, & Enterococcus bacteria; Climate change and sea level rise.
<b>III. Forested and Emergent Wetlands</b>		
Red Maple/Seaside Alder Swamp	Based on current knowledge this community does not exist anywhere else in Delaware or North America (DNHP-2007); Rare plants found here include seaside alder (S2/G3), green-fringe orchid (S3), Mitchell's sedge and gibbonous grass (S2); Rare animal species include Carpenter Frog (S1), Cope's Gray Treefrog (S1), Ribbon Snake (S2), Rough Green Snake (S2), Great Purple Hairstreak (S1), several rare firefly species ( <i>Photuris spp.</i> ), & <i>Praeclara Underwing</i> Moth (S1); <b>Target Rocs: Prothonotary Warbler, Acadian Flycatcher, &amp; Yellow-throated Vireo.</b>	This community is anthropogenically maintained by the refuge's Unit III Impoundment Infrastructure (2 large water control structures & mile-long dike) that provides water level management capabilities within 2,500 acres of emergent marsh. Drastic alterations to water levels on Prime Hook Creek could negatively impact rare plants and animals dependent on the Red Maple/Seaside Alder Swamp community; Groundwater withdrawals.
Atlantic White Cedar/Seaside Alder Swamp	Community is distinguished by Atlantic White Cedar in the canopy & seaside alder (S3) in the understory. Several rare plants associated with this habitat type include: coast sedge (S1), bayonet rush (S2), & flattened pipewort (S2). Rare Herps are also associated: Carpenter Frog (S1) – only 2 known populations extant in De; Cope's Gray Treefrog (S1), Ribbon Snake (S2), & Rough green snake (S2).	Habitat fragmentation and loss; Lack of fire to regenerate white cedar stands; Invasive species.

Habitat Type	Reasons for Ranking	Limiting Factors/Threats
<b>PRIORITY I HABITATS (cont.)</b>		
<b>III. Forested and Emergent Wetlands (cont.)</b>		
Swamp Cottonwood Coastal Plain Pond	Only a few examples of this community remain in Delaware. State and Regionally rare and globally uncommon (S1/G3 Tier 1) Marbled Underwing Moth resides within this community in association with its host plant, swamp cottonwood. <b>Target Rocs: <i>Catocala marmorata</i>, <i>Populus heterophylla</i>, breeding &amp; migrating landbirds.</b>	Drainage ditches dug for refuge farming, eutrophication from Ag-fertilizer and pesticide runoff, & high beaver densities, invasive species.
Coastal Plain Freshwater Depression Ponds	Coastal plain ponds are unique non-tidal, isolated freshwater depression ponds surrounded by forested canopy. Globally rare (G2) refuge depression ponds provide habitat for several state rare-plants: slender blue-flag iris (S2), cattail sedge (S3) & Robbins spike-rush (S3). Rare state animal species supported by this community include Carpenter Frog (S1), Cope Gray Tree Frog (S1), Great Purple Hairstreak (S1) & Marbled Underwing (S1).	Delaware Heritage scientists rank this community for protection as these areas are not legally regulated by Delaware; Ponds are vulnerable to destruction via ditching, draining, filling-in wet areas & agricultural runoff of nutrients & pesticides. They are also threatened by groundwater depletion due to large irrigation systems adjacent to refuge lands that alter hydrology supporting these habitats; Mosquito Adulticide & Dimilin pesticide applications kill rare invertebrates.
Buttonbush Coastal Plain Pond	Globally Ranked G3 with very few occurrences in mid-Atlantic region, and <b>Habitat of Conservation Concern</b> in Delaware Wildlife Action Plan.	Community is threatened by groundwater alteration, agricultural run-off of fertilizers and pesticides and drainage ditches.
Twig-Rush Peat Mat Community	Unique and rare community in Delaware and found nowhere else in the state; Several populations of Twig Rush (S1), Ten-Angle Pipewort (S1), Umbrella Flat-sedge (S1), Bushy Bluestem (S1) & Tawny Cotton Grass (S1) support the most floristically diverse habitat-type on the refuge and in Delaware with over 66 uncommon plant species documented by DNHP (Delaware Natural Heritage Program), including 24 very rare state plant species and rare invertebrate and amphibian species. <b>Target Rocs: Identified as Tier 1 SGCN in DWAP – Pitcher Plant Moth, Elfin Skimmer; Sphagnum Sprite, Blueberry Dart, &amp; several fire fly species.</b>	Invasive plant species; Poor Water Quality; Pesticide contamination from Agricultural runoff; Mosquito Adulticide or Dimilin chemical applications, and salt water intrusion.

Habitat Type	Reasons for Ranking	Limiting Factors/Threats
<p><b>PRIORITY I HABITATS (cont.)</b></p> <p><b>III. Forested and Emergent Wetlands (cont.)</b></p> <p>Emergent Impounded Wetlands</p>	<p>Refuge Habitat-type acreage (4,200 acres) offers greatest contribution to BIDEH of freshwater habitats not well represented in state and eco-region. Water level management capability creates habitat food resources for a large number of priority ROCS especially migrating and wintering ducks, migrant Canada Geese (spring &amp; fall), significant anadromous fish resources and state rare invertebrate SGCN. Six key perennial freshwater wetland communities and annual moist-soil vegetation support the best populations of S1 &amp; S2 – Tier 2 invertebrates listed in DWAP. The lack of other sites in Delaware plus the concentration of rare invertebrate species exemplify the importance of PHNWR’s impounded wetlands to rare species’ long-term persistence in the state. <b>Target Rocs: Black Rail, Virginia Rail, Clapper Rail, Forster Tern, Least Bittern, American Bittern, Pied-billed Grebe, American Black Duck, Northern Pintail, Canada Geese; breeding and migrating shorebirds especially Dunlin, Yellowlegs, Short-billed Dowitcher, Avocets; Alewife, Blue-back Herring, Stripe-Bass, American Eel, American Shad &amp; Hickory Shad; Lilypad forktail damselfly (<i>Ischnura kelticotti-S1</i>), Elfyn Skimmer (<i>Nannothemis bella-S1</i>), and (<i>Photuris pensylvanica-S2</i>) firefly.</b></p>	<p>Exotic plant invasions, especially <i>Phragmites</i> &amp; <i>Ludwigia leptocarpa</i>; Water quality issues due to eutrophication both from on-refuge and off-refuge point sources of agricultural run-off; Mercury contamination; Ground water depletion from large commercial irrigation systems adjacent to refuge lands; Mosquito adulticide applications and associated drift effects; ten 25 foot-wide drainage ditches on private property feeding directly into Prime Hook Creek Unit III impoundment; Accidental spills of toxin and sewage; Groundwater withdrawals; Control of Mosquitoes and Forest Pests by Aerial Application of Pesticides; Climate Changes; Seal Level Rise, and salt water intrusion.</p>
<p><b>PRIORITY II HABITATS</b></p> <p>Mid-Atlantic Maritime Salt Shrub</p>	<p>Dominated by <i>Iva frutescens</i> or <i>Baccharis halimifolia</i> within associated salt marsh areas; Important shrub component includes <i>Morella cerifera</i>; <b>Target Roc <i>Catocala muliercula</i> (DE – only occurrence –State Record): DWAP &amp; DNHP recommends targeting as SGCN by conserving areas which contain host plant (<i>M. cerifera</i>).</b></p>	<p>Storm surges can cause shrub-die back; Invasive species encroachment; Control of Mosquitoes and Forest Pests by Aerial Application of Pesticides having negative impacts on invertebrates.</p>

Habitat Type	Reasons for Ranking	Limiting Factors/Threats
<b>PRIORITY II HABITATS (cont.)</b>		
<b>III. Forested and Emergent Wetlands (cont.)</b>		
Successional Maritime Forest	Community consists of 184 acres of stunted forest of blackberry & sweetgum w/some red maple; Shrub layer dominated by <i>Morella cerifera</i> & <i>pensylvanica</i> ; Community Ranked G2G3, restricted in range to coastal areas of 7 NE states; <b>Target ROCS : <i>Catocala muliercula</i>; Several high priority BCR 30 and PIF 44 bird species like Prairie Warbler; Migrating songbirds;</b>	Community is naturally restricted to areas directly affected by maritime processes (e.g., salt spray and bay winds); Other threats include succession, lack of disturbance & invasive plants. Historic habitat in Delaware eliminated by extensive residential development, road expansion, & recreation.
Coastal Plain Depression Swamp	3 Coastal Plain communities have been inventories on PHNWR. <b>Target ROCS: Spring &amp; Fall migrating songbirds; State rare plants include <i>Carex typhina</i> (S3), &amp; <i>Iris prismatica</i> (S2); Rare animals include Carpenter Frog, Cope's Gray Treefrog, Ribbon Snake, Rough Green Snake, Great Purple Hairstreak, Delaware Skipper, <i>Catocala praeclara</i>.</b>	Nitrates, phosphates & pesticides from agricultural run-off; Invasive species encroachment.
Coastal Loblolly Pine Wetland Forest	Supports uncommon plant species but refuge only contains 91 acres; Ranked as G3 community due to limited distribution dominate shrub species <i>Morella cerifera</i> . <b>Target ROCS: Priority BCR 30 &amp; PIF 44 breeding &amp; migrating landbirds.</b>	Lack of fire; Invasive plants; Landscape position of this community limited to mid-Atlantic (DE, MD, VA, NC) faces development pressures & degradation from agricultural practices.
Successional Sweetgum, Loblolly Sweetgum & Red Maple Sweetgum Forests	Soils in these associations have been negatively impacted by agricultural practices & are recovering from poor soil fertility; Sweetgum components naturally restore native soil biota & are eventually replaced by oaks, hickories and/or pines;	Invasive encroachment especially from Multiflora Rose and Japanese Stiltgrass.
Wax-Myrtle Shrub Swamp	Supports uncommon plant species & associated rare invertebrates, but refuge contains only a small portion of this community type (67 acres); <b>Target Rocs: <i>Catocala muliercula</i></b> by securing the health of host plant (Wax-myrtle).	Habitat loss & degradation; Invasive species encroachment especially <i>Phragmites</i> & Mile-A-Minute; Mosquito Adulticide Use
Water-Willow Shrub Swamp	Community dominated by broad-leaved deciduous shrub <i>Decodon verticillatus</i> & associated w/ Peat-Bog communities. Refuge contains only a small portion of this habitat-type. <b>Target Rocs: Migratory landbirds &amp; waterfowl.</b>	Salt water intrusion & invasive species encroachment.

Habitat Type	Reasons for Ranking	Limiting Factors/Threats
<b>PRIORITY II HABITATS (cont.)</b>		
<b>III. Forested and Emergent Wetlands (cont.)</b>		
Brackish Tidal Creek Shrub Swamp	Connected to high & low salt marsh. <b>Target Rocs: Prairie warbler, short-eared owl, sedge wren, coastal plain swamp sparrow.</b>	Heavy salt spray & tidal flooding from severe storms can cause die-back in shrub layers; <i>Phragmites</i> encroachment.
Early Successional Upland Habitats	Semi-natural Northeast Successional Shrub & Fallow agricultural fields. <b>Target Rocs: Prairie Warbler, Blue winged warbler, Brown thrasher, Eastern Towee, Field Sparrow, Northern Bobwhite, Whip-poor-will, Willow Flycatcher, Woodcock, <i>Papaipema maritime</i> S1- maritime sunflower borer moth, migrating warblers and other landbirds.</b>	Invasive species encroachment; Lack of habitat manipulations (Fire, Mowing, Hydro-axe) to set back succession.

- American Oystercatcher is a state endangered species. Horseshoe crabs have been listed as a sensitive & significant Delaware keystone species, & ASMFC-listed species w/ MAFMC Fishery Management Plan & TNC Ecoregion target species. Red Knot, Sanderling, Whimbrel & Beach Dune Tiger Beetle are Tier 1 listed species in Delaware Wildlife Action Plan (DWAP-2005).
- Tier 1 species as identified by the state are those species that are in need of immediate conservation action in order to sustain or restore their populations. Tier 1 species are the major focus of the DWAP (Delaware Wildlife Action Plan) which is based on analyzing threats that impact their populations and habitats, and on developing conservation actions to eliminate, compensate or minimize identified threats.

Appendix D-6. Priority Resources of Concern for Prime Hook NWR

Keystone Resources of Concern		Life History and Habitat Structure Requirements == => (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type ==> (Goals)		
<p><b>American Oystercatcher</b> Umbrella species for all breeding shorebirds dependent on Overwash and Beach Habitats.</p>	<p><b>BARRIER BEACH ISLAND HABITATS</b></p> <ul style="list-style-type: none"> <li>• Overwash Grassland Dunes</li> <li>• Atlantic Coastal Interdune Swale</li> </ul>	<p>Breeding: Nest in coastal habitats with little vegetative cover; mostly sandy beaches, or blowout areas in dunes. They feed on invertebrates found in overwash habitats and/or wrack piles at the high tide line.</p>	<p>Piping Plover; Red Knot, Ruddy Turnstone, Black-billed Plover; Black Skimmer; Great-black-backed gull, American Black Duck, Willet, Common tern, Forster's tern, Least tern, Common night-hawk, Eastern towhee, Savannah sparrow, Diamond Back Terrapin, Horseshoe Crab, Migrating and Wintering waterfowl and wading birds, rare state listed invertebrate &amp; native plant species.</p>
<p><b>Sanderling</b></p>		<p>Migration/Wintering: Feed on small crabs, aquatic and terrestrial invertebrates in sandy beaches and/or dune overwash areas.</p>	
<p><b>Whimbrel</b></p>		<p>Migration: Sandy beach, tidal flats, shorelines and wet open fields. Food – primarily marine invertebrates and small crabs.</p>	

Keystone Resources of Concern		Life History and Habitat Structure Requirements == => (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type ==> (Goals)		
<p><b>Beach Dune Tiger Beetle</b> (<i>Cicindela hirticollis</i>) Keystone and Indicator species of healthy Sandy Beach and Dune Grassland Habitats.</p>		<p>Life History: Larval burrows are shallow (8-20 cm) in sandy soils where subsurface soil is constantly moist. They over winter as either adult or a larva. Adults are active from April-Oct. with 2 peaks: April to late June and early August – September. Females that oviposit in late June or July have their larvae reaching the third instar stage by late September. They only occur in sandy beach habitats or in overwash areas (very uncommon in De) with high rates of erosion and low plant density. Their tight association with patchily distributed, early successional, sandy areas makes them excellent keystone organisms for barrier beach island habitats. Within Delaware’s natural landscape, <i>Cicindela hirticollis</i> also considered an indicator species of good quality beach communities (beach and panicgrass) dune grassland associations.</p>	
<p><b>Migratory Shorebirds</b> dependent on overwash dune grasslands</p>	<ul style="list-style-type: none"> <li>• Irregularly Flooded Eastern Tidal Salt Shrub</li> <li>• Maritime Red Cedar Woodland</li> <li>• Successional Maritime Forest</li> </ul>	<p>Feeding and roosting habitats during May and June migrational period and July through October migration.</p>	
<p><b>Migratory Landbirds</b> dependent on Maritime Shrub, Red Cedar Woodland, and Successional Maritime Forest</p>		<p>Feeding and roosting habitats during spring and fall migrational periods.</p>	
<p><b>Little Wife Underwing</b> (<i>Catocala muliercula</i>) Indicator species of healthy Irregularly flooded Eastern tidal salt shrub and Red Cedar Woodland communities.</p>		<p>Resident State Record: Host plant is southern bayberry (<i>Morella cerifera</i>). State recommends conserving all communities with a significant component of host plant representative of irregularly flooded eastern tidal salt shrub.</p>	

Keystone Resources of Concern		Life History and Habitat Structure Requirements = => (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type => (Goals)		
<p><b>Delmarva fox squirrel</b> Umbrella Species for large patches of mixed hardwood forest habitats, forest interior dwelling songbirds, and migratory landbirds.</p>	<p><b>FORESTED UPLAND HABITATS (775 acres)</b></p> <ul style="list-style-type: none"> <li>• Southern Red Oak/Heath Forest</li> <li>• Mesic Coastal Plain Oak Forest</li> <li>• Mid-Atlantic Coastal Plain Loblolly Pine Forest</li> <li>• Northern Coastal Plain Mesic Hardwood Forest</li> <li>• Mid-Atlantic Mesic Mixed Hardwood Forest</li> <li>• Successional Sweetgum</li> <li>• Northern Coastal Plain Basic Mesic Hardwood Forest</li> <li>• Pond Pine Woodland</li> </ul>	<p>Both upland and bottomland forests are occupied; Upland forest must contain a variety of nut-bearing (hardwoods) and seed-bearing trees (loblolly); Mature forest stands also contain over-age trees bearing hollows for den sites; <u>Winter Food Resources</u>: Hard mast production – (HSI model describes potential for optimum mast production will occur where a mix of white and red oaks, hickories, walnuts and other mast producing trees comprise at least 40% of total canopy cover ; with mast producing trees <math>\geq</math> 15 dbh. As tree canopy closure increases (&gt; 60%), mast quality and quantity is reduced due to suppression and shading of tree crowns by adjacent trees. Optimum canopy closure between 20% to 60% . Canopy closure less than 20% or greater than 60 % is indicative of less suitable habitat for DFS. Generally, understory vegetation comprised of shrubs can decrease habitat quality. Optimum conditions occur when shrub crown closure is 30% or less. Habitat quality will decrease as the shrub density increases above 30% regardless of tree canopy closure and overstory size.</p>	<p>Frosted elfin, Marbled underwing, Tearful underwing, Noctuid moths (<i>Zeta metata &amp; metatoides</i>), American Red Start, Blue-winged Warbler, Worm-eating Warbler, Eastern wood pewee, Willow flycatcher, Eastern phoebe, Louisiana waterthrush, Eastern towhee, Baltimore oriole, Chuck will's widow, Red-bellied woodpecker, Downy woodpecker, Hairy woodpecker, Red-headed woodpecker, Cooper's Hawk, Red-tailed hawk, Barred owl, Silver-haired bat, Eastern Red bat, Hoary bat, Coyote, Deer, Turkey, Eastern box turtle, Five-lined skink, Corn snake, Red salamander and other native reptiles &amp; amphibians.</p>
<p><b>Wood Thrush</b> Nest Location/Type: Canopy/Open Cup Feeding Location = Canopy</p>		<p>Breeding: Mature deciduous or mixed (oak/pine) forests, preferably late-successional, mesic forests with a moderately dense shrub-subcanopy layer; moist soil and leaf litter: Trees taller than (50 feet), fairly open with substrate moisture more important than canopy cover: Probability of occurrence increases with forest patch size to a maximum of 500 (ha) (1235 acres) but does occur in fragments as small as 25 acres.</p>	

Keystone Resources of Concern		Life History and Habitat Structure Requirements = => (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type => (Goals)		
<p><b>Black and White Warbler</b> Nest Location/Type: Ground/Open Cup Feeding Location: Canopy at mid-story.</p>		<p>Breeding: Area sensitive species that nests in mature and second-growth moist deciduous and mixed hardwood forests. Highly sensitive to forest fragmentation requiring blocks <math>\geq</math> 740 acres (299 ha).</p>	
<p><b>Scarlet Tanager</b> Nest Location/Type: Canopy/Open Cup Feeding Location = Canopy</p>		<p>Nests in mature deciduous forest, mixed swamp and floodplain forests and rich moist upland forests; Prefers oak trees &gt; 9 inch dbh, with relatively closed canopy, a dense understory with a high diversity of shrubs; minimum forest area needed to sustain a viable population from 10-15 ha. In Maryland, 50% occurrence is reached for forest patches of 15 ha but 100 ha (250 acres) has been suggested as optimal patch size.</p>	
<p><b>Yellow-throated Vireo</b> Nest = Canopy/Open Cup Feeding Location: High in canopy</p>		<p>Nests in rich mesophytic deciduous forest similar to Scarlet Tanager breeding habitat requirements.</p>	
<p><b>Kentucky Warbler</b> Nest = Understory or ground/Open Cup Feeding Location = Ground</p>		<p>Breeding Habitats include mesophytic and rich deciduous forest, secondary growth and swamps with a slightly open canopy, dense understory and well-developed ground cover.</p>	
<p><b>Great Crested Flycatcher</b> Nest = Snag/Cavity Feeding Location = Ground</p>		<p>Mature deciduous and mixed deciduous-coniferous forest near swamps and open water areas but more tolerant of forest fragmentation. Accepts a wide range of open to moderately closed canopy situations.</p>	
<p><b>Northern Flicker</b> Nest Location = Snag/Cavity Feeding Location = Sub-canopy</p>		<p>Open woodlands and edges of mature forest and or open areas with dead trees. Declining Flicker populations mostly due to loss of suitable nesting sites (dead trees).</p>	

Keystone Resources of Concern		Life History and Habitat Structure Requirements == => (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type ==> (Goals)		
<p><b>Whip-poor-will</b> Nest Location: Ground/Scrape Feeding Location: Sparse understory and open areas.</p>		Deciduous and mixed upland forest adjacent to open areas (fields, wetlands or open water) with well spaced trees and a low canopy. Uncommon in mature forest, prefers even-aged successional habitats from regeneration to pole-stage stands. Data suggest that average home range (~ 125 acres or 50 ha) and most home ranges contain 50% open habitat.	
<p>Bay-breasted Warbler &amp; <b>Migratory Landbirds</b></p>		Migration: Seasonal frugivores; Many mature forest breeders use early successional habitats during post breeding periods with tall canopies (shrub-sapling canopies) that provide structured resources for protection from aerial predators and microhabitats with plentiful fruit and insect food resources. Radar studies have demonstrated that refuge forested upland areas are critical stopover habitats for fall migrating songbirds on Delmarva Peninsula.	
<p><b>Bald Eagle</b></p>		Breeding: Upland mature deciduous, coniferous or mixed forest near fishable waters. Coastal location of PHNWR makes anadromous fish species important food items in spring and summer; and large numbers of waterfowl are most important prey in fall and winter. Wintering: Congregate in large trees with stout branches, protection from storm winds and seclusion from human activity.	
<p><b>Long-horned beetle</b> (<i>Prionus laticollis</i>)</p>		Indicator Species of mature, healthy, diverse hardwood forest.	

Keystone Resources of Concern		Life History and Habitat Structure Requirements = => (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type => (Goals)		
Acadian Flycatcher	<p><b>FORESTED WETLAND HABITATS (1,238 acres)</b></p> <ul style="list-style-type: none"> <li>• Red Maple/Seaside Alder Swamp</li> <li>• Coastal Plain Depression Swamp</li> <li>• Atlantic White Cedar/Seaside Alder Saturated Forest</li> <li>• Swamp Cottonwood Coastal Plain Pond</li> </ul>	Habitat generalist in mature wet or moist deciduous forests with dense understory. Breeds in large tracts of mature mesic forest patches with shrubby understory near creek or stream; often associated with swamps surrounded by dry forest tracts.	Delmarva Fox Squirrel's critical late winter and early spring feeding habitats; Black-crown and Yellow-crowned night herons; Wood Thrush, Northern Parula, American redstart, Worm-eating warbler; Kentucky warbler; rare obligate amphibian species like Carpenter Frog and Cope's Gray Treefrog, Eastern Ribbon Snake, Rough Green Snake, Eastern Spadefoot, Wood duck, other common reptile and amphibian species.
Prothonotary Warbler		Breeding: Requires swampy lowland forest or palustrine woods near standing water; especially mature bottomland hardwood forests subjected to flooding; Requires variety of natural cavities (2 to 35 feet high) over water.	
Yellow-throated Vireo		Mature floodplain forests and/or moist rich upland oaks (20-60 feet) tall; will also use deciduous-coniferous forest edge; Feeds extensively on moth and butterfly larvae in canopy of mature woods.	
Migratory Landbirds		Radar studies showed that refuge forested wetland areas provide critical stopover habitats for songbirds (esp. warblers & sparrows) during spring migration up the Delmarva Peninsula.	

Keystone Resources of Concern		Life History and Habitat Structure Requirements = => (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type => (Goals)		
<b>Black Rail</b>	<p><b>SALT MARSH HABITATS (2,200 acres)</b></p> <ul style="list-style-type: none"> <li>• North Atlantic High Marsh</li> <li>• North Atlantic Low Marsh</li> <li>• Irregularly flooded Eastern tidal Salt Shrub</li> <li>• Salt Pannes</li> </ul>	<p>Breeding: Coastal salt and brackish marsh areas where nests are placed in high salt marsh flooded during extreme high tides. Nests placed in areas dominated by salt hay (<i>Spartina patens</i>). These areas may also contain spike grass (<i>Distichlis spicata</i>), black rush (<i>Juncus gerardi</i>), or marsh elder (<i>Iva frutescens</i>). Low salt marsh habitats dominated by salt-marsh cordgrass (<i>S. alterniflora</i>) are less favorable.</p>	<p>Detritus consumers and small carnivores: copepods, insect larvae, grass shrimp, mysids, amphipods, nematodes, fiddler crabs, bivalve mollusks; sheepshead and other minnow fish species, leaf hoppers, seaside dragonfly, other insect species, Common tern, King rail, Sora, Pied-billed grebe, Black-necked stilt, Sedge wren, Marsh wren, American bittern, Northern harrier, Peregrine falcon, Marsh rice rat and other small mammals, short-eared and barn owls,;</p>
<b>Clapper Rail</b>		<p>Breeding: Preferred habitat is <i>Spartina</i> marsh and tend to concentrate along tidal creeks; Nests are usually in dense cover near water and built well above high tide mark; Diet &gt; 90% animal matter; mostly parasitic worms (Ascaridae), clam worms (<i>Nereis Spp.</i>), shrimp (<i>Palaeomonetes Spp.</i>), snails (<i>Littorina &amp; Melampus Spp.</i>), fiddler crabs (<i>Uca Spp.</i>) and fish (<i>Fundulus Spp.</i>) but fiddler crabs is the most important food associated with smooth cordgrass. Tall form <i>S. alterniflora</i> along ditches and ditched ponds provide the best breeding habitats.</p>	
<b>Least Tern</b>		<p>Breeding: Require open sand, soil, or dried mud in proximity of an estuary, river or tidal creek. Nests are located in areas of sparse vegetation and will not nest in areas with &gt; 20% vegetation cover or in areas of tall vegetation. Nesting sites characterized as unstable areas created and maintained by tidal action or flooding with food requirements related to abundance and accessibility of small fish.</p>	
<b>Gull-billed tern</b>		<p>Breeding: In sandy beaches and saltwater coastal areas; forages over salt marshes and other open coastal areas mostly for insects &amp; small fish.</p>	

Keystone Resources of Concern		Life History and Habitat Structure Requirements = => (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type => (Goals)		
<b>Black skimmers</b>		Breeding: Coastal beach, sandbars, and/or salt marsh; feeds on aquatic invertebrates and small fish.	
<b>Whimbrel</b>		Migration: Use wetlands, salt marsh habitats and mudflats at low tide; migrating and wintering diets include worms, grubs, fiddler crabs and other aquatic organisms.	
<b>Willet</b>		Breeding: In salt marshes, shallow brackish marshes, wet meadows, mudflats, and/or native grassland habitats.	
<b>Sharp-tailed Sparrow</b>		Breeds exclusively in high salt marsh; Significant microhabitat characteristics of breeding populations include: 1) suitable elevated nest sites where there is a deep layer of <i>Spartina patens</i> thatch to protect nests from periodic tidal and storm flooding & 2) nearby openings in vegetation, pools, pannes or ditch edges and open mud for foraging; Optimum habitat contains nesting and feeding microhabitats in close proximity. <i>Junco gerardi</i> is a good indicator of the very best saltmarsh sharp-tailed habitat.	
<b>Seaside Sparrow</b> Keystone and indicator species of healthy <i>Spartina</i> High and Low Salt Marsh.		Salt marsh specialists and indicator species of salt marsh ecosystem health; Wider habitat tolerance than sharp-tail sparrow; also found nesting in low salt marsh areas not used by sharp-tails. Presence of tall-form <i>S. alterniflora</i> good indicator of seaside sparrow habitat.	
<b>Coastal Plain Swamp Sparrow</b> Keystone and Indicator species of North Atlantic High Marsh, Maritime Shrub and Irregularly Flooded Eastern Tidal Salt Shrub.		Mid-Atlantic wetland specialist breeding from May to September. Favors <i>Spartina</i> High Marsh areas within a specific zone of salinity (< 15 ppt) consisting of patches of High Tide Bush ( <i>Iva frutescens</i> ) with an understory of salt hay ( <i>S. patens</i> ). Other plant species are often used as singing perches by males like <i>Spartina. cynosuroides</i> . Tidal guts and brackish ponds also present within optimal breeding habitats. Patches of <i>Schoenoplectus americanus</i> and <i>S. cynosuroides</i> are predictors of greatest nest success while <i>Iva</i> patches are marginal.	

Keystone Resources of Concern		Life History and Habitat Structure Requirements = => (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type => (Goals)		
American Black Duck		<p>Wintering: Four variables limit ABDU use on estuarine open water (subtidal &amp; intertidal) habitats critical for loafing, resting, feeding and escape habitats. These include 2 physical variables (water depth &amp; presence of tidal flats) &amp; 2 biological factors (aquatic plant &amp; clam densities. Optimal subtidal open water is (&lt; 1m deep) with 30% to 70% availability of shallow tidal waters interspersed with exposed mud flat feeding habitats ranging from 20-60% cover. This habitat structure provides critical animal foods in winter diet (mussels, snails, clams, crabs, amphipods &amp; decapods), especially when impounded habitats are covered by snow or ice. Quality of water feeding habitats that support rooted vascular aquatic plant beds (&gt;20%) occupied by <i>Ruppia</i> and/or <i>Potamogeton</i> are best. Optimal invert densities in wintering salt marsh habitats = &gt;300 clams/m<sup>2</sup>.</p>	
American Black Duck	<p><b>IMPOUNDED FRESH/BRACKISH WETLANDS (4,200 acres)</b></p>	<p>Impounded marshes with associated ponds and creeks also provide food and protection from storms, escape and resting cover. Optimal hemi-marsh conditions with &gt;25% emergent vegetation supporting <math>\geq 750</math> snails/m<sup>2</sup> about (= 70 snails/ft<sup>2</sup>) preferred.</p>	<p>Hérons &amp; Egrets, Osprey, Black-crowned night-heron, Gull-billed tern, Common tern, Mallard, Green-winged teal, Blue-winged teal, Ring-necked duck, Northern shoveler, American widgeon, Gadwall, Wood duck, Canada geese, snow geese, Tundra Swan, Banded Sun Fish, Four Spine Stickle Back, Black-Banded Sun Fish, Comely Shiner, White and Yellow perch.</p>
Northern Pintail		<p>Wintering: Prefer large, open shallow marshes with extensive emergent and submerged vegetation between 5 – 30 cm deep; Feeds on predominantly native plant seeds and vegetative material; Important moist-soil seeds include barnyard grass, sedges, smartweeds; important invertebrate foods in winter include snails, chironomids, &amp; beetle (Coleoptera larvae); In brackish habitats wigeongrass, alkali bulrush, sea purslane and spike rush also provide good food and cover..</p>	

Keystone Resources of Concern		Life History and Habitat Structure Requirements ==> (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type => (Goals)		
Fall Migrating & Wintering Dabbling Ducks		Greatest densities in lacustrine, littoral, emergent, nonpersistent wetlands, characterized by beds of aquatic vegetation, emergent vegetation, interspersed with open water. Food consumption mostly, plant (75%) foods, with some animal (25%) foods.	
	Spring Migrating Dabbling Ducks	Habitat Use & Staging Areas: Concentrate on larger wetland patches > 100 acres, with greater consumption of animal (65%) foods to plant (35%) foods.	
	Snow Geese	Strategies to decrease: Modify Refuge upland habitat management of open field areas by reducing the acreage in agricultural habitats in favor of more natural habitats, to reduce Snow Goose use, increase migratory landbird use and benefit E/T species.	
Virginia Rail		Breeding: Prefers fresh or brackish marshes with shallow water and abundant emergent vegetation; Constructs nest in cattails or sedges just above shallow water, covered with a loose canopy of vegetation. Attaches nest to surrounding vegetation or on a clump of grass or tussock. Diet includes snails, worms and occasional small fish.	
Forster's Tern		Breeding: Extensive marshy areas (salt to freshwater) with vegetated nest sites partly open to water; Usually nests in small colonies (1-10 birds) on mats of floating dead vegetation, flattened cattails, muskrat houses near edges of open water and/or shallow depression in sand or mud; Sometimes uses abandoned nests of Pied-billed Grebes; Also <i>Spartina</i> grasses are often important components of nesting habitat as they are a major component of wrack and provide escape cover for chicks.	

Keystone Resources of Concern		Life History and Habitat Structure Requirements = => (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type => (Goals)		
Least Bittern		Breeding and wintering least bitterns inhabit freshwater to brackish wetlands, with dense emergent vegetation such as cattail and bulrush; Patches of > 5 ha with rank and tall (> 1m) emergent vegetation over relatively deep water (30-70 cm) interspersed with patches of open water are required for breeding; Nests usually placed over water or near open water; Diet consists of fish, tadpoles, aquatic insects and aquatic insects. Least Bitterns prefer more densely vegetated, deeper water habitats than American bitterns.	
American Bittern		In comparison to the sympatric Least Bittern, American Bittern uses a wider variety of wetland cover types. <u>Breeding:</u> Shallow freshwater wetlands with abundant emergent vegetation interspersed with patches of open water and aquatic-bed vegetation; Readily use wetlands created by impoundments associated with water depths < 10 cm with sparse to dense vegetative cover in patches > 25 ha. Slow, incomplete drawdown of impoundments can promote favorable emergent vegetative areas with appropriate water levels, while maintaining populations of small fish, amphibians and aquatic invertebrates.	
Dunlin		Migration: Favors coastal habitats with mudflats or sand flats, open beaches, tidal ditches and creeks and flooded grassland; Impounded mudflat habitats with water depths (0-4 cm) and invertebrate densities $\geq 4$ gm/m <sup>2</sup> .	
Short-billed Dowitcher		Migration: Shallow pools in salt marshes, sandy beaches or impounded wetland mudflat habitats with water depth range from 2 to 8 cm and aquatic insect densities $\geq 4$ gm/m <sup>2</sup> .	

Keystone Resources of Concern		Life History and Habitat Structure Requirements = => (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type => (Goals)		
American Avocet		Spring/Fall Migration: Wetlands bordered by open flats or areas with scattered tufts of native grasses interspersed with open water.	
Greater/Lesser Yellowlegs		Migration: Shallow fresh, brackish and salt waters, mudflats, tidal flats, marshes and pools, rain pools in fields, and damp grassy meadows.	
River Herring; Important ecological roles in freshwater and estuarine food webs occupying level between zooplankton (their principal food) and piscivores. <b>Alewife &amp; Blue-Back Herring:</b>		Schools of river herring enter estuarine & freshwater habitats once a year to spawn from March to July. Juvenile dispersal back to ocean from Oct – Nov or following spring. Habitat Cover Needs: Large creeks, streams and ponds including barrier beach ponds. Spawning substrates include sand, soft substrates, detritus and submerged vegetation with sluggish water flows and water depths from 15 cm to 3 m. Food for Larva & Juvenile: Larvae feed on copepods; Young-of-the year consume Chironomidae until July, switching to cladocerans in August to October.	
American Eel		Highly migratory with spawning and larval development and migration occurring in open ocean; Feeding/growth (elvers) occurring in estuarine and freshwater habitats, with migration of adults out to ocean again (Catadromous Life Cycle). Glass eels migrate into estuaries and freshwater habitats and metamorphose to elvers. Preferred freshwater habitats include lentic and lotic habitats where elvers feed mostly on invertebrates.	

Keystone Resources of Concern		Life History and Habitat Structure Requirements = => (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type => (Goals)		
<b>Striped Bass</b>		<p>Adults migrate in early spring from Atlantic Ocean to freshwater habitats and juveniles migrate back to ocean in 2 – 5 years.</p> <p><b>Nursery Requirements &amp; Larvae Habitat:</b> Survival of larvae depends on temperature, salinity &amp; D. O. Optimal temps (18 – 21°C with tolerances 12 -23 ° C) and salinity ranges 2 to 10 ppt. Low dissolved oxygen causes larvae mortality. Larvae food includes mysid shrimp, amphipods and fish up to 20 mm in length. Juveniles feed on mysids and insects.</p>	
<b>Rare Plant Communities</b>	Impounded Freshwater Wetlands	Maintenance of Impoundment Infrastructure (Dikes, water control structures and dunes) to control salt water intrusion and set back succession in impounded wetlands.	See HMP for extensive list of rare plant communities and associated rare fauna dependent on these communities.
<p><b>Prairie Warbler</b> Nest Location = Subcanopy/ Open Cup Feeding Location: Subcanopy</p>	<p><b>Early Successional Upland Habitats</b></p> <ul style="list-style-type: none"> <li>• <b>Grasslands</b></li> <li>• <b>Shrublands</b> <ul style="list-style-type: none"> <li>• <u>Transitional Shrubland</u></li> <li>• <u>Young Shrubland</u></li> <li>• <u>Old Shrubland</u></li> </ul> </li> <li>• <b>Transitional forested areas in saplings</b></li> </ul>	<p>Optimal breeding habitats = <u>Young Shrubland</u> with herbaceous vegetation &lt; 20 cm (8 in) tall with patches of sparse cover: Other associated habitats include poor soils, brushy dune areas, coastal pine subclimax, burned-over and cut-over areas, fallow fields with scattered trees, corridors in hardwood swamps and grassland-forest ecotone.</p>	<p>Frosted elfin, American burying beetle, migrating and resident butterfly species, other early upland successional-dependent invertebrate species, Eastern box turtle, Milk snake, Short-eared owl, Northern Harrier; Common nighthawk, Black-billed and yellow billed cuckoos, Chestnut-sided Warbler, Yellow Warbler; Chimney swift, Least Flycatcher; Eastern Kingbird, Yellow-breasted Chat, Vesper Sparrow, Savannah Sparrow, Grasshopper Sparrow, Henslow sparrow, Black-bellied Plover; Migratory Canada geese, American woodcock, Least shrew, rare plant species.</p>

Keystone Resources of Concern		Life History and Habitat Structure Requirements = => (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type => (Goals)		
<p><b>Blue-winged Warbler</b> Nest Location = Vine Tangle/Open Cup Feeding Location: subcanopy</p>		<p>Migrating: Dense growth near borders of swamps or creeks, woodland edges, brushy overgrown fields and thickets. Optimal breeding habitat = <u>Old Shrubland</u>. Prefers old fields with saplings greater than 3 m tall.</p>	
<p><b>Brown Thrasher</b> Nest Location = Ground/Cup Feeding Location: Sub-canopy</p>		<p>Optimal breeding habitat = <u>Young Shrubland</u>. Other associated habitats b include brushy edges of woodlands, dry thickets, overgrown fields, early successional woodlands, forest ecotones, shrubby undergrowth in open woods.</p>	
<p><b>Whip-poor-will</b> Nest Location: Ground/No nest Feeding Location: open areas</p>		<p>Breeding structural habitat requirements include <u>Old Shrubland</u> and open woodland, early successional forest, brushy field edges or deciduous and/or mixed forests with little to no brushy understory.</p>	
<p><b>Willow Flycatcher</b> Nest Location: Subcanopy/open cup Feeding Location = Canopy and subcanopy</p>		<p>Optimal breeding habitats = <u>Young Shrubland</u>: Fairly open areas with scattered shrubs. Breeding habitats range from brushy fields, shrubby swales to open woodland edges; Prefers edge habitats that include thickets or areas with small trees and shrubs surrounded by grasslands.</p>	
<p><b>Eastern Towhee</b> Nest Location: Shrub/Cup Feeding Location: Shrub/Thickets</p>		<p>Optimal breeding habitat = <u>Young Shrubland</u>: Habitat includes dense brushy areas, edges of woods, hedgerows and road thickets.</p>	
<p><b>Field Sparrow</b> Nest Location = Shrub or sapling/Open Cup Feeding Location = Shrub/Thickets</p>		<p>Optimal breeding habitat = <u>Transitional Shrubland</u>: Habitat includes areas with short structured grasses with shrubs or low trees, brushy hedgerows, abandoned fields where briars and brush starting to regenerate.</p>	

Keystone Resources of Concern		Life History and Habitat Structure Requirements == => (Objectives)	Other Benefiting Species
Focal Species or Focal Group	Habitat Type ==> (Goals)		
<p><b>Northern Bobwhite</b> Nest Location = Tall grasslands and shallow depression lined with grass on ground Feeding Location = Ground in early successional habitats</p>		<p>Optimal breeding habitat = <u>Grassland</u>: Variety of early successional habitats including native grasslands, hedgerows, woodlands with grass and forbs ground cover, active and fallow crop fields. Regular habitat disturbance critical in maintaining bobwhite habitat. Grassland community types adjacent to <u>Transitional Shrublands</u> with defined edges provide ideal nesting, brood-rearing, feeding, loafing, travel and escape cover.</p>	
<p><b>Henslow's Sparrow</b> Umbrella species for entire suite of early successional, grassland-dependent species, both breeding and migrating.</p>		<p>Optimal breeding habitat: Patch sizes <math>\geq 30</math> ha (75 acres) in moderately tall grassy vegetation (<math>&gt; 30</math> cm), with well-developed litter layer and minimal woody species encroachment (<math>&lt; 20\%</math>).</p>	
<p><b>Papaipema maritima</b> (S1-Maritime Sunflower Borer Moth); This species is thought to represent a subspecies near the brink of extirpation and was last recorded in Delaware in 1934. Indicator species of healthy early successional grassland habitats.</p>		<p>Rarest animal species found in state surveys of Refuge habitats (2004-2005). Species is totally dependent on the giant sunflower (<i>Helianthus giganteus-S3</i>) that thrives in herbaceous early successional habitats.</p>	

Appendix D–Table A. Species List and Priority Refuge Habitats for Prime Hook National Wildlife Refuge in Milton, Delaware of the Coastal Delaware National Wildlife Refuge Complex

Species List and Priority Refuge Habitats	Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 44 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>
	<b>I. BARRIER ISLAND BEACH HABITATS</b>													
Overwash Dunes (Priority I Habitat)			X					X						
Beachgrass/Panicgrass Dune Grassland (Priority I)			X					X						
Atlantic Coast Intertidal Swale (Priority I)			X					X						
Maritime Red Cedar Woodland (Priority I)			X					X						
Mid-Atlantic Maritime Salt Shrub (Priority II)			X					X						
Successional Maritime Forest (Priority II)			X					X						
<b>II(A). FORESTED UPLAND HABITATS</b>														
Southern Red Oak/Heath Forest (Priority I)			X					X						
Mesic Coastal Plain Oak Forest (Priority I)			X					X						
Coastal Loblolly Pine Forest (Priority I)			X					X						
Mesic Coastal Plain Rich Forest (Priority I)			X					X						
Mesic Coastal Plain Mixed Hardwood Forest (Priority I)			X					X						
Pond Pine Sweetbay Prickly Bog Sedge (Priority I)			X					X						
Successional Sweetgum; Red Maple Sweetgum Forest (Priority II)			X					X						

Species List and Priority Refuge Habitats		Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 4 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>	
<b>II(B). WETLAND FORESTS</b>																
	Red Maple/Seaside Alder Swamp (Priority I)			X					X							
	Atlantic White Cedar/Seaside Alder Saturated Forest (Priority I)			X					X							
	Swamp Cottonwood Coastal Plain Seasonal Pond (Priority I)			X					X							
	Coastal Plain Depression Swamp (Priority II)			X					X							
	Coastal Loblolly Pine Wetland Forest (Priority II)			X					X							
<b>III. WETLANDS</b>																
	Coastal Plain Freshwater Depressional Ponds (Priority I)			X					X							
	Twig-Rush Peat Mat Community (Priority I)			X					X							
	Button-Bush Coastal Plain Pond (Priority I)			X					X							
	Emergent Impounded Wetlands (Priority I)			X					X							
	Wax-myrtle Shrub Swamp (Priority II)			X					X							
	North Atlantic High Salt Marsh (Priority I)			X					X							
	Water Willow Shrub Swamp (Priority II)			X					X							
	Brackish Tidal Creek Shrubland (Priority II)			X					X							
	North Atlantic Spartina Low Salt Marsh (Priority I)			X					X							
<b>IV. EARLY SUCCESSIONAL UPLAND HABITATS</b>																
	Native Grassland and Herbaceous			X					X							
	Native Transitional Habitats : Grassland/ Shrubland/Young Trees			X					X							

# Species List and Priority Refuge Habitats

Species	Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 44 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>
<b>WATERBIRDS</b>														
American bittern <i>Botaurus lentiginosus</i>	SpSF	X				M		2				-	HH	
American coot <i>Fulica americana</i>	FW	X						2					L	
American white pelican <i>Pelecanus erythrorhynchos</i>	S	X												
Arctic tern <i>Sterna paradisaea</i>	SpF	X						2				H	HH	
Audubon's shearwater <i>Puffinus lherminieri</i>	SpF	X				H		1				HI	HH	
Black rail <i>Laterallus jamaicensis</i>	SpSF	X			E	HH	1a	1	X			-	HH	
Black skimmer <i>Rhynchos niger</i>	SpSF	X			E	M	1a	1	X			H	HH	
Black-crowned night heron <i>Nycticorax nycticorax</i>	Yr	X			E			1				M	HH	
Black-headed gull <i>Larus ridibundus</i>	W	X												
Brown pelican <i>Pelecanus occidentalis</i>	S	X						2					M	
Cattle egret <i>Bubulcus ibis</i>	SpSF	X						2					M	
Caspian tern <i>Sterna caspia</i>	SpSF	X										L	L	
Clapper rail <i>Rallus longirostris</i>	Yr	X				H	2b					-	H	
Common Moorhen <i>Gallinula chloropus</i>	SpSF	X						2				M	L	
Common tern <i>Sterna hirundo</i>	SpSF	X			E	M		1	X			L	HH	
Cory's shearwater <i>Calonectris diomedea</i>	W	X				M						M	H	
Double-crested cormorant <i>phalacrocorax auritus</i>	Yr	X						2					L	
Forster's tern <i>Sterna forsteri</i>	Yr	X			E	H	2b	1				M	H	
Glossy ibis <i>Plegadis falcinellus</i>	Yr	X				H		2				L	HH	

# Species List and Priority Refuge Habitats

Species	Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 4 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>
	Yr	X						2					L	
Great black-backed gull <i>Larus marinus</i>	Yr	X						2					L	
Great blue heron <i>Ardea herodias</i>	Yr	X						2					H	
Great cormorant <i>Phalacrocorax carbo</i>	SpW	X						2					H	
Great egret <i>Ardea alba</i>	Yr	X						2					M	
Greater shearwater <i>Puffinus gravis</i>	W	X				H		2				H	HH	
Green Heron <i>Butorides virescens</i>	SpSF	X												
Gull-billed tern <i>Sterna nilotica</i>	SpS	X				HH		2				H	HH	
Herring gull <i>Larus argentatus</i>	Yr	X										L	H	
King rail <i>Rallus elegans</i>	SpF	X				M	1b	2				-	HH	
Laughing gull <i>Larus atricilla</i>	SpSF	X												
Least bittern <i>Icobyrychus exilis</i>	SpS	X				M		2				-	HH	
Least tern <i>Sterna antillarum</i>	SpSF	X			E	H	1a	1	X			H	HH	
Little blue heron <i>Egretta caerulea</i>	SpSF	X				M		2				H	HH	
Northern gannet <i>Morus bassanus</i>	SpS	X				H						N	M	
Pied-billed grebe <i>Podilymbus podiceps</i>	Yr	X			E			1					HH	
Red-throated loon <i>Gavia stellata</i>	SpSF	X				HH		2				-	HH	
Roseate tern <i>Sterna dougalli</i>	SF	X		E		HH		1				H	HH	
Ross' gull <i>Rhodostethia rosea</i>	W	X												
Royal tern <i>Sterna maxima</i>	SpSF	X				M							H	
Snowy egret <i>Egretta thula</i>	Yr	X				M		2				H	HH	

# Species List and Priority Refuge Habitats

	Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 4 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>
<b>WATERBIRDS (cont.)</b>														
Sora		X				M		2				-	H	
Tricolored heron	SpSF	X				M		2				H	HH	
Virginia rail	Yr	X					2a							
Yellow rail	SpF	X						2					H	
Yellow-crowned night heron	SpS	X			E	M		1				M	H	
<b>WATERFOWL</b>														
American black duck	Yr	X				HH	1a	1						D
American wigeon	FW	X				M								S
Atlantic brant	FW	X				HH		2						S
Black-bellied whistling duck	FW	X												
Black scoter	FW	X				H		2						D
Blue-winged teal	SpSF	X												S
Bufflehead	SpFW	X				H		2						I
Canada goose – Atlantic Population	FW	X				HH								I
Canada goose – N. Atlantic	FW	X				H		1						U
Resident Canada Geese	Yr													I
Canvasback	W	X				H								
Common eider	W	X				H		2						S
Common goldeneye	SpFW	X				M								S

Species List and Priority Refuge Habitats		Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 44 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>	
		Yr SpFW	X X				M H M M M		2 2 2 2 2							I S I S I
<b>WATERFOWL (cont.)</b>																
	Gadwall <i>Ana strepera</i>	Yr	X				M									I
	Greater scaup <i>Aythya marila</i>	SpFW	X				H		2							S
	Green-winged teal <i>Anas crecca carolinensis</i>	Yr	X				M									I
	Harlequin duck <i>Histrionicus histrionicus</i>	W	X				M									S
	Hooded merganser <i>Lophodytes cucullatus</i>	Yr	X				M		2							I
	King eider <i>Somateria spectabilis</i>	W	X													
	Lesser scaup <i>Aythya affinis</i>	SpFW	X				H		2							D
	Long-tailed duck <i>Clangula hyemalis</i>	SpFW	X				H		2							D
	Mallard <i>Ana platyrhynchos</i>	Yr	X				H		2							S
	Northern pintail <i>Anas acuta</i>	SpFW	X				M									D
	Northern shoveler <i>Anas clypeata</i>	SpFW	X						2							
	Red-breasted merganser <i>Mergus serrator</i>	SpFW	X				M									I
	Redhead <i>Aythya americana</i>	SpFW	X						2							
	Ring-necked <i>Aythya collaris</i>	SpFW	X						2							
	Ruddy duck <i>Oxyura jamaicensis</i>	Yr	X				M									I
	Snow Geese <i>Chen caerulescens</i>	Sp FW	X													I
	Surf scoter <i>Melanitta perspicillata</i>	FW	X				H		2							D
	Tundra swan – Eastern <i>Cygnus columbianus</i>	SpFW	X				H		2							I
	White-winged scoter <i>Melanitta fusca</i>	FW	X				H		2							D
	Wood duck – Eastern <i>Aix sponsa</i>	Yr	X				M									I

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Species	Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 4 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>
<b>SHOREBIRDS</b>														
American avocet <i>Recurvirostra americana</i>	SpSF	X				M					3			
American golden plover <i>Pluvialis dominica</i>	SpSF	X				H		2			4			
American oystercatcher <i>Haematopus palliatus</i>	SpS	X			E	HH	1a	1	X		5			
American woodcock <i>Scolopax minor</i>	Yr	X				HH	1a	1			5			
Baird's sandpiper <i>Calidris bairdii</i>	SF	X									2			
Black-bellied plover <i>Pluvialis squatarola</i>	SpSF	X				H		2			3			
Black-necked stilt <i>Himantopus mexicanus</i>	SpSF	X						2						
Buff-breasted sandpiper <i>Tryngites subruficollis</i>	F	X				H		2	X		4			
Common snipe <i>Gallinago delicata</i>	Yr	X				M					3			
Dunlin <i>Calidris alpina</i>	Yr	X				H		2			3			
Eskimo curlew <i>Numenius borealis</i>				E							5			
Greater yellowlegs <i>Tringa melanoleuca</i>	Yr	X				H		2			4			
Hudsonian godwit <i>Limosa haemastica</i>	SpSF	X				H		2	X		4			
Killdeer <i>Charadrius vociferous</i>	Yr	X				M					2			
Least sandpiper <i>Calidris minutilla</i>	Yr	X				M					3			
Lesser yellowlegs <i>Tringa flavipes</i>	Yr	X				M					2			
Long-billed dowitcher <i>Limnodromus scolopaceus</i>	SpSF	X									2			
Marbled godwit <i>Limosa fedoa</i>	SpF	X				H		2	X		4			
Pectoral sandpiper <i>Calidris melanotos</i>	SpSF	X									2			
Piping plover <i>Charadrius melodus</i>	SF	X		T	E	HH	1a	1			5			

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	W	X				H		1	X					
Purple Sandpiper <i>Calidris maritima</i>	W	X				H								
Red knot <i>Calidris melodus</i>	SpS	X				HH		1	X		5			
Red phalarope <i>Phalaropus fulicarius</i>	SpF	X				M					3			
Red-necked phalarope <i>Phalaropus lobatus</i>	SpSF	X				M		2			3			
Ruddy turnstone <i>Arenaria interpres</i>	Yr	X				HH					4			
Ruff <i>Philomachus pugnax</i>	SpF	X						1			4			
Sanderling <i>Calidris alba</i>	Yr	X				HH								
Semipalmated plover <i>Charadrius semipalmatus</i>	SpSF	X				M					2			
Semipalmated sandpiper <i>Calidris pusilla</i>	SpSF	X				H		2			4			
Short-billed dowitcher <i>Limnodromus griseus</i>	Yr	X				H		2			3			
Solitary sandpiper <i>Tringa solitaria</i>	SpSF	X				H		2			3			
Spotted sandpiper <i>Actitis macularius</i>	SpSF	X				M		1			3			
Stilt sandpiper <i>Calidris himantopus</i>	SpSF	X									3			
Upland sandpiper <i>Bartramia longicauda</i>	SpSF	X			E	M	1b	1	X		4			
Western sandpiper <i>Calidris mauri</i>	SpSF	X				M					2			
Whimbrel <i>Numenius phaeopus</i>	SpS	X				HH		1	X		5			
White-rumped sandpiper <i>Calidris fuscicollis</i>	SpSF	X				H		2			3			
Willet <i>Tringa semipalmata</i>	SpSF	X				H	2b	2			4			
Wilson's phalarope <i>Phalaropus tricolor</i>	SpSF	X				H		2			3			
Wilson's plover <i>Charadrius wilsonia</i>	SpS	X				H	1b	2	X		4			

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	SpSF	Yr													
Acadian flycatcher <i>Empidonax virescens</i>	SpSF	X													
American kestrel <i>Falco sparverius</i>	Yr	X													
American redstart <i>Setophaga ruticilla</i>	SpSF	X						1							
American robin <i>Turdus migratorius</i>	Yr	X													
Bachman's sparrow							M								
Bald eagle <i>Haliaeetus leucocephalus</i>	Yr	X				E	M	3	1						
Baltimore oriole <i>Icterus galbula</i>	SpSF	X					H		2	X					
Bank swallow <i>Hirundo rustica</i>	SpSF	X							2						
Barn owl <i>Tyto alba</i>	Yr	X							2						
Barred owl <i>Strix varia</i>	Yr	X							2						
Bay-breasted warbler <i>Dendroica castanea</i>	SpF	X					H								
Bicknell's thrush <i>Catharus bicknelli</i>	SpF	X					H		1						
Blackburnian warbler							M								
Black-capped chickadee <i>Poecile atricapillus</i>	Yr	X							1						
Black-throated blue warbler <i>Dendroica caerules</i>	SpF	X													
Black-throated green warbler <i>Dendroica virens</i>	SpF	X													
Black vulture <i>Coragyps atratus</i>	Yr	X							2						
Black-and-white warbler <i>Mniotilta varia</i>	SpSF	X					H		2						
Black-billed cuckoo <i>Coccyzus erythrophthalmus</i>	SpSF	X							2						
Blue-gray gnatcatcher <i>Polioptila caerulea</i>	SpSF	X													

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	SpF	X					1b	1 2	X					
Blue-headed vireo <i>Vireo solitarius</i>	SpF	X												
Blue-winged warbler <i>Vermivora pinus</i>	SpF	X					1b	1	X					
Bobolink <i>Dolichonyx oryzivorus</i>	SpF	X						2						
Broad-winged Hawk		X				H								
Brown creeper <i>Certhia americana</i>	SpFW	X			E			1						
Brown thrasher <i>Toxostoma rufum</i>	Yr	X				H	2a	2						
Brown-headed nuthatch <i>Sitta pusilla</i>	Yr	X				M	1b	2						
Canada warbler <i>Wilsonia canadensis</i>	SpSF	X				M	1b	2	X					
Cedar waxwing <i>Bombycilla cedrorum</i>	Yr	X												
Cerulean warbler <i>Dendroica cerulea</i>	SpSF	X			E	M		1	X					
Chestnut-sided warbler <i>Dendroica pensylvanica</i>	SpSF	X						2						
Chimney swift <i>Chaetura pelagica</i>	SpSF	X				H	2a	2						
Chuck-will's-widow <i>Caprimulgus carolinensis</i>	SpSF	X												
Coastal plain swamp sparrow <i>Melospiza Georgiana nigrescens</i>	Yr	X				M								
Common nighthawk <i>Chordeiles minor</i>	SpSF	X						1						
Common yellowthroat <i>Geothlypis trichas</i>	Yr	X												
Cooper's hawk <i>Accipter cooperii</i>	Yr	X			E			1						
Eastern bluebird <i>Sialia sialis</i>	SpS	X				H								
Eastern kingbird <i>Tyrannus tyrannus</i>	SpSF	X						2						
Eastern phoebe <i>Sayornis phoebe</i>	Yr	X												

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		Yr SpSF	X X						2a 2a 2a	2 2 2	X X X					
LANDBIRDS (cont.)																
Eastern towhee <i>Pipilo erythrophthalmus</i>		Yr	X						2a	2						
Eastern wood-pewee <i>Contopus virens</i>		SpSF	X						2a							
Field sparrow <i>Spizella pusilla</i>		Yr	X				H		2a	2						
Golden crowned kinglet <i>Regulus satrapa</i>		Yr	X													
Golden-winged warbler <i>Vermivora chrysoptera</i>		SpF	X				M			2	X					
Grasshopper sparrow <i>Ammodramus savannarum</i>		SpSF	X				M		2c	2						
Gray catbird <i>Dumetella carolinensis</i>		Yr	X				M		2a							
Great crested flycatcher <i>Myiarchus crinitus</i>		SpSF	X				H			2						
Henslow's sparrow <i>Ammodramus henslowii</i>		S	X				H	E	1b	1	X					
Hermit thrush <i>Catharus</i>		SpSF	X													
Hooded warbler <i>Wilsonia citrina</i>		SpSF	X							1						
Horned Lark <i>Eremophila alpestris</i>		SpSF	X													
Ipswich Savannah Sparrow							M									
Kentucky warbler <i>Oporornis formosus</i>		SpSF	X				H		1a	2	X					
Least flycatcher <i>Empidonax minimus</i>		SpSF	X							2						
Loggerhead shrike <i>Lanius ludovicianus</i>							E			1						
Long-eared owl <i>Asio otus</i>		W	X							1						
Louisiana waterthrush <i>Seiurus motacilla</i>		SpS	X				H		2c	2						
Marsh wren <i>Cistothorus palustris</i>		Yr	X				H		2a	2	X					
Merlin <i>Falco columbarius</i>		SpFW	X													

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	W	X				M								
Nelson's sharp-tailed sparrow <i>Ammodramus nelsoni</i>	W	X				M								
Northern bobwhite <i>Colinus virginianus</i>	Yr	X				H	2a	2						
Northern flicker <i>Colaptes auratus</i>	Yr	X				H		2						
Northern harrier <i>Circus cyaneus</i>	Yr	X			E			1						
Northern shrike <i>Lanius excubitor</i>	W	X												
Northern waterthrush <i>Seiurus noveboracensis</i>	SpF	X												
Northern parula <i>Parula americana</i>	SpFW	X			E			1						
Orange-crowned warbler <i>Vermivora celata</i>	F	X												
Osprey <i>Pandion haliaetus</i>	SpSF	X						1						
Peregrine falcon	SpFW	X						2	X					
Palm warbler <i>Dendroica palmarum</i>	SpF	X												
Pine warbler <i>Dendroica pinus</i>	Yr	X												
Prairie warbler <i>Dendroica discolor</i>	SpSF	X					1a	1	X					
Prothonotary warbler <i>Protonotaria citrea</i>	SpSF	X				H	1a	2						
Red-breasted nuthatch <i>Sitta canadensis</i>	SpFW	X												
Red-eyed vireo <i>Vireo olivaceus</i>	SpSF	X					1b							
Red-headed woodpecker <i>Melanerpes erythrocephalus</i>	Yr	X			E	M	1b	1	X					
Red-shouldered hawk <i>Buteo lineatus</i>	Yr	X						2						
Saltmarsh sharp-tailed sparrow <i>Ammodramus caudacutus</i>	Yr	X					1a	1	X					

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	SpFW	Yr													
Savannah sparrow <i>Passerculus sandwichensis</i>	SpFW		X						2						
Scarlet tanager <i>Piranga olivacea</i>	SpSF		X				H	2a	2						
Seaside Sparrow <i>Ammodramus maritimus</i>	Yr		X				M	1a	1	X					
Sedge wren <i>Cistothorus platensis</i>	Yr		X			E	M	2c	1	X					
Sharp-shinned hawk <i>Accipiter striatus</i>	SpFW		X						1						
Short-eared owl <i>Asio flammeus</i>	SpFW		X			E	M	1b	1	X					
Summer tanager <i>Piranga rubra</i>	SpSF		X												
Swainson's warbler <i>Catharus ustulatus</i>	SF		X			E	M	1b	1						
Veery <i>Catharus fuscescens</i>	SpF		X						2						
Vesper sparrow <i>Poocetes gramineus</i>	SpS		X						2						
Warbling vireo <i>Vireo gilvus</i>	SpS		X						2						
Whip-poor-will <i>Caprimulgus vociferus</i>	SpSF		X				H	2a	2	X					
White-breasted nuthatch <i>Sitta carolinensis</i>	Yr		X												
White-eyed vireo <i>Vireo griseus</i>	SpSF		X												
Willow flycatcher <i>Empidonax traillii</i>	SpSF		X				H	1b	2						
Wood thrush <i>Hylocichla ustulata</i>	SpSF		X					1a	1	X					
Worm-eating warbler <i>Helmitheros vermivorum</i>	SpS		X				H	1a	2	X					
Yellow-billed cuckoo <i>Coccyzus americanus</i>	SpSF		X												
Yellow-breasted chat <i>Icteria virens</i>	Yr		X						2						
Yellow-rumped warbler <i>Dendroica coronata</i>	SpFW		X												

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	SpSF	X													
<b>LANDBIRDS (cont.)</b>															
Yellow-throated vireo <i>Vireo flavifrons</i>	SpSF	X					H	2a	2						
Yellow-throated warbler <i>Denroica dominica</i>	SpSF	X							2						
Yellow warbler <i>Dendroica petechia</i>	SpSF	X													
<b>MAMMALS</b>															
American beaver <i>Castor canadensis</i> (S3)	Yr														
American mink <i>Mustela vison</i> (S3)	Yr														
Big brown bat <i>Eptesicus fuscus</i>	Yr														
Coyote <i>Canis latrans</i>	Yr								2						
Delmarva fox squirrel <i>Sciurus niger cinereus</i>	Yr	X	E	E					1						
Eastern cottontail <i>Sylvilagus floridanus</i>	Yr														
Eastern gray squirrel <i>Sciurus carolinensis</i>	Yr														
Eastern mole <i>Scalopus aquaticus</i>	Yr														
Eastern pipistrelle <i>Pipistrellus subflavus</i>	Yr														
Eastern red bat <i>Lasiurus borealis</i>	Yr								2						
Eastern small-footed bat	Yr								1						
Evening bat <i>Nycticeius humeralis</i>									2						
Gray fox <i>Urocyon cinereoargenteus</i>	Yr														
Hoary bat <i>Lasiurus cinereus</i>	Yr								2						
Little brown bat <i>Myotis lucifugus</i>	Yr														
Long-tailed weasel <i>Mustela frenata</i>	Yr								2						

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		Yr													
<b>MAMMALS (cont.)</b>															
	Marsh rice rat <i>Oryzomys palustris</i> (S3)	Yr													
	Maryland shrew <i>Sorex fontinalis</i>														
	Masked shrew <i>Sorex cinereus</i>	Yr													
	Meadow jumping mouse <i>Zapus hudsonius</i>	Yr							2						
	Meadow vole <i>Microtus pennsylvanicus</i>	Yr													
	Muskrat <i>Ondatra zibethicus</i>	Yr													
	North American least shrew <i>Cryptotis parva</i>	Yr													
	Northern raccoon <i>Procyon lotor</i>	Yr							2						
	Northern river otter <i>Lutra canadensis</i>	Yr													
	Red fox <i>Vulpes vulpes</i>	Yr													
	Short-tailed shrew <i>Blarina brevicauda</i>	Yr													
	Silver-haired bat <i>Lasionycteris noctivagans</i>	Yr							2						
	Southern flying squirrel <i>Glaucomys volans</i>	Yr													
	Star-nosed mole <i>Condylura cristata</i> (S4)	Yr													
	Striped skunk <i>Mephitis mephitis</i>	Yr													
	Virginia opossum <i>Didelphis marsupialis</i>	Yr													
	White-footed mouse <i>Peromyscus leucopus</i>	Yr													
	White-tailed deer <i>Odocoileus virginianus</i>	Yr													
	Woodchuck <i>Marmota monax</i>	Yr													
	Woodland vole <i>Microtus pinetorum</i> (S4)	Yr													

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		Yr														
<b>AMPHIBIANS</b>																
	American bullfrog <i>Rana catesbeiana</i>	Yr														
	Barking tree frog <i>Hyla gratiosa</i>	Yr				E			1							
	Carpenter frog <i>Rana virgatipes</i>	Yr				SI			1							
	Cope's gray treefrog <i>Hyla versicolor</i>	Yr				SI			2							
	Eastern cricket frog <i>Acris creoitans crepitans</i>	Yr														
	Eastern mud salamander <i>Pseudotriton montanus montanus</i>	Yr							2							
	Eastern spadefoot toad <i>Scaphiopus holbrookii</i>	Yr							2							
	Eastern red-backed salamander <i>Plethodon cinereus</i>	Yr														
	Eastern Tiger salamander <i>Ambystoma tigrinum tigrinum</i>					E			1							
	Four-toed salamander <i>Hemidactylium scutatum</i>	Yr							2							
	Fowler's toad <i>Bufo fowleri</i>	Yr														
	Green treefrog <i>Hyla cinerea</i>	Yr														
	Marbled salamander <i>Ambystoma opacum</i>	Yr														
	New Jersey chorus frog <i>Pseudacris feriarum kalmi</i>	Yr														
	Northern green frog <i>Rana clamitans melanota</i>	Yr														
	Northern red salamander <i>Pseudotriton ruber ruber</i>	Yr														
	Northern spring peeper <i>Pseudacris crucifer crucifer</i>	Yr														
	Pickrel frog <i>Rana palustris</i>	Yr														
	Southern leopard frog <i>Rana sphenoccephala sphenoccephala</i>	Yr														

# Species List and Priority Refuge Habitats

Species	Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 44 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>
<b>AMPHIBIANS (cont.)</b>														
Spotted salamander <i>Ambystoma maculatum</i>	Yr							2						
Wood frog <i>Rana sylvatica</i>	Yr													
<b>REPTILES</b>														
Atlantic green turtle <i>Chelonia mydas mydas</i>				T	E			1						
Atlantic hawksbill turtle <i>Eretmochelys imbricata imbricata</i>				E				2						
Atlantic leatherback turtle <i>Dermochelys coriacea</i>				E	E			1						
Atlantic loggerhead turtle <i>Caretta caretta</i>				T	E			1						
Black rat snake <i>Elaphe obsoleta obsoleta</i>	Yr													
Bog turtle <i>Glyptemys muhlbergii</i>				T	E			1						
Broadhead skink <i>Eumeces laticeps</i>								1						
Corn snake <i>Elaphe guttata guttata</i>	Yr				E			1						
Diamond Back Terrapin <i>Malaclemys terrapin terrapin</i>	SpSF							2						
Eastern box turtle <i>Terrapene carolina carolina</i>	Yr							1						
Eastern hognose snake <i>Heterodon platirhinos</i>	Yr							2						
Eastern kingsnake <i>Lampropeltis getula getula</i>	Yr							2						
Eastern milk snake <i>Lampropeltis triangulum</i>								1						
Eastern mud turtle <i>Kinosternon subrubrum subrubrum</i>	Yr													
Eastern painted turtle <i>Chrysemys picta picta</i>	Yr													
Eastern snapping turtle <i>Chelydra serpentina serpentina</i>	Yr													
Kemp's ridley sea turtle <i>Lepidochelys kempii</i>				E	E			1						

# Species List and Priority Refuge Habitats

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<b>REPTILES (cont.)</b>														
Northern black racer <i>Coluber constrictor constrictor</i>	Yr													
Northern brown snake <i>Storeria dekayi dekayi</i>	Yr													
Northern copperhead <i>Agkistrodon contortrix mokasen</i>								2						
Northern red-bellied snake <i>Storeria occipitomaculata occipitomaculata</i>	Yr							2						
Northern water snake <i>Nerodia sipedon sipedon</i>	Yr													
Queen snake <i>Regina septemvittata</i>								2						
Redbelly water snake <i>Nerodia erythrogaster</i>								1						
Red-bellied turtle/Northern red-bellied cooter <i>Pseudemys rubiventris</i>	Yr							2						
Ribbon Snake <i>Thamnophis sauritus sauritus</i>	Yr				S2			2						
Rough green snake <i>Ophedryx aestivus aestivus</i>	Yr				S2			2						
Smooth/Eastern earthsnake <i>Virginia valeriae</i>								2						
Spotted turtle <i>Clemmys guttata</i>	Yr				S2			1						
Stinkpot <i>Sternotherus odoratus</i>	Yr													
<b>FISH</b>														
Alewife <i>Alosa pseudoharengus</i>	SpS	X								D				
American brook lamprey <i>Lampetra appendix</i>								2		D				
American Eel <i>Anguilla rostrata</i>	SpSF	X			S1			1						
American Shad <i>Alosa sapidissima</i>	SpSF	X						1						

# Species List and Priority Refuge Habitats

Species List and Priority Refuge Habitats		Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 4 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>
		SpSF	X						2		D				
Atlantic croaker <i>Micropogonias undulatus</i>		SpSF	X						2		D				
Atlantic silverside <i>Menidia menidia</i>		SpSF	X								D				
Atlantic sturgeon <i>Acipenser oxyrinchus oxyrinchus</i>						E			1						
Banded killifish <i>Ictalurus melas</i>		Yr													
Banded sunfish <i>Enneacanthus obessus</i>		Yr				S2			2						
Bay anchovy <i>Anchoa mitchilli</i>		SpS							2						
Black bullhead <i>Ictalurus melas</i>		Yr													
Black crappie <i>Pomoxis nigromaculatus</i>		Yr													
Blueback herring <i>Alosa aestivalis</i>		SpSS	X								D				
Blue ridge sculpin <i>Cottus caeruleomentum</i>		Yr							1						
Bluespotted sunfish <i>Enneacanthus gloriosus</i>		Yr													
Bridle shiner <i>Notropis bifrenatus</i>									1						
Brown bullhead <i>Ameiurus nebulosus</i>		Yr													
Brown Shiner <i>Ameiurus nebulosus</i>		Yr													
Carp <i>Cyprinus carpio</i>		Yr				SE									
Chain pickerel <i>Esox niger</i>		Yr													
Channel catfish <i>Ictalurus punctatus</i>		Yr													
Comely shiner <i>Notropis amoenus</i>		Yr				S2			2						
Cravelle jack <i>Caranx hippos</i>		Yr													
Eastern mudminnow <i>Umbra pygmaea</i>		Yr													

Species List and Priority Refuge Habitats		Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 4 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>	
<b>FISH (cont.)</b>																
	Fat sleeper <i>Dormitator maculatus</i>	SpS							2							
	Fourspine stickleback <i>Apeltes quadracus</i>	SpSF				S2			2							
	Gizzard shad <i>Dorosoma cepedianum</i>	SpSF														
	Glassy darter <i>Etheostoma vitreum</i>	Yr							2							
	Hickory shad <i>Alosa mediocris</i>	SpSF		X		S2			2							
	Inland silverside <i>Menidia beryllina</i>	Yr														
	Ironcolor shiner <i>Notropis chalybaeus</i>								1							
	Largemouth bass <i>Micropterus salmoides</i>	Yr														
	Mosquito fish <i>Gambusia affinis</i>	Yr														
	Least brook lamprey <i>Lampetra aepyptera</i>															
	Mud sunfish <i>Acantharchus pomotis</i>	Yr				S2			1							
	Mummichog <i>Fundulus heteroclitus</i>	Yr														
	Naked goby <i>Gobisoma bosc</i>	Yr														
	Pumpkinseed <i>lepomis gibbosus</i>	Yr														
	Rainwater killifish <i>Lucania parva</i>	Yr														
	Redbreast sunfish <i>Lepomis auritus</i>	Yr														
	Rough silverside <i>Membras martinica</i>	Yr														
	Round whitefish <i>Prosopium cylindraceum</i>	Yr														
	Sheepshead minnow <i>Cyprinodon variegatus</i>	Yr														
	Shield darter <i>Percina peltata</i>								1							D

# Species List and Priority Refuge Habitats

Species	Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 4 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>
<b>FISH (cont.)</b>														
Shorthead rehorse <i>Moxostoma macrolepidotum</i>								1						
Shortnose sturgeon <i>Acipenser brevirostrum</i>				E				1						
Spot <i>Leiostomus xanthurus</i>	Yr							1						
Spotfin killifish <i>Fundulus luciae</i>	Yr				SS			2						
Striped bass <i>Morone saxatilis</i>	SpSF		X							I				
Striped killifish <i>Fundulus majalis</i>	Yr													
Striped mullet <i>Mugil cephalus</i>	Yr													
Summer flounder <i>Paralichthys dentatus</i>	SpSF													
White catfish <i>Ameiurus catus</i>	Yr													
White crappie <i>Pomoxis annularis</i>														
White mullet <i>Mugil curema</i>	Yr													
White perch <i>Morone americana</i>	Yr													
White shark <i>Carcharodon carcharias</i>								2						
White sucker <i>Catostomus commersoni</i>	Yr													
Yellow bullhead <i>Ameiurus natalis</i>	Yr				SS			1						
Yellow perch <i>Perca flavescens</i>	Yr													
<b>SHELLFISH</b>														
Atlantic marsh fiddler crab <i>Uca pugnax</i>	Yr													
Blue claw <i>Callinectes sapidus</i>	Yr													

# Species List and Priority Refuge Habitats

	Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 4 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>
	Yr													
<b>SHELLFISH (cont.)</b>														
Mud crab <i>Rithropanopeus harrisi</i>	Yr													
Red-jointed fiddler crab <i>Uca minax</i>	Yr													
<b>INVERTEBRATES (730+ species documented only a few are listed)</b>														
American burying beetle				E				1						
Bethany beach firefly					E			1						
Frosted elfin					E			1						
Hessel's hairstreak					E			1						
King's hairstreak					E			1						
Mulberry wing					E			1						
Northeastern beach tiger beetle				T				2						
Rare skipper					E			1						
Seth forest water scavenger beetle					E			1						
Spectral / Little white / Dune ghost tiger beetle					E			1						
White tiger beetle					E			1						
Beach Dune Tiger Beetle <i>Cincindela hirticollis</i>	Yr				S1			2						
Bronze Copper <i>Lycaena hyllus</i>	SpSF				S2			2						
<i>Catocala lacrymosa</i> (Tearful underwing)	Yr				S1			1						
<i>C. marmorata</i> (SIG3) (Marbled underwing)	Yr				S1			1						

# Species List and Priority Refuge Habitats

Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 4 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>
<b>INVERTEBRATES (cont.)</b> (730+ species documented only a few are listed)													
Yr													
SpSF				SI			2						
Yr				SI			2						
Yr				SI			2						
Yr				SI			2						
Yr				SI			2						
Yr				SI			2						
Yr				SI			2						
Yr				SI			2						
Yr				SI			1						
				SI			1						
Yr				SI			1						
Yr				SI			1						
Yr				SI			1						
Yr													
Yr				SI			1						
Yr													
Yr													

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Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 44 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>
<b>INVERTEBRATES (cont.)</b> (730+ species documented only a few are listed)													
Yr				S1			1						
	Sphagnum sprite <i>Nehalennia gracilis</i>												
Yr				S1			2						
	Young blueberry darter <i>Xestia youngii</i>												
Yr				S2			2						
	<i>Zale metata</i> (STATE RECORD)												
Yr				S2			2						
	<i>Z. metatoides</i>												
<b>FRESHWATER MUSSELS</b> (Unknown - No Inventories or Research ever conducted on Refuge)													
	Alewite floater						2						
	Angular disc						2						
	Armed snaggletooth						2						
	Black gloss						2						
	Brook floater			E			1						
	Coastal plain tigersnail						2						
	Creepers/ Squawfoot						2						
	Crested vertigo						2						
	Dwarf wedgemussel		E	E			1						
	Eastern lampmussel			E			1						
	Eastern pond mussel			E			1						
	Flamed tigersnail						2						
	Glass spot						2						
	Gray-foot lancetooth						2						
	Hairy slitmouth						2						

# Species List and Priority Refuge Habitats

Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 44 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>
	Honey vertigo						2						
	Northern lance mussel						2						
<b>FRESHWATER MUSSELS (cont.) (Unknown – No Inventories or Research ever conducted on Refuge)</b>													
	Northern three-tooth						2						
	Obese thorn						2						
	Pyramid dome						2						
	Slender walker						2						
	Swamp vertigo						2						
	Tidewater mucket			E			1						
	Toothed hive						2						
	Triangle floater						1						
	White-lip dagger						2						
	Winding mantleslug						2						
	Yellow lampmussel			E			1						
<b>PLANTS</b>													
	American Chaffseed		E										
	Seabeach amaranth		T										
	Canby's dropwart		E										
	Knieskern's beaked-rush		T										

# Species List and Priority Refuge Habitats

Seasons on Refuge <sup>1</sup>	Refuge Purpose Species	BIDEH	Federal T&E for DE <sup>2</sup>	State T&E <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 44 <sup>5</sup>	State Comprehensive Wildlife Conservation Plan Priorities <sup>6</sup>	USFWS Birds of Conservation Concern <sup>7</sup>	Federal Trust Fish Species (USFWS Trend Data) <sup>8</sup>	Shorebird Plan-Atlantic Flyway <sup>9</sup>	Waterbird Plan <sup>10</sup>	MANEM Conservation Priority <sup>11</sup>	Waterfowl Plan <sup>12</sup>
<b>PLANTS (cont.)</b>													
			T										
			T										
			T										

**Individual Rare Plant Species recorded on Refuge (See Habitat Management Plan {HMP} for comprehensive plant species list and state rankings)**

<sup>1</sup>Seasons on the Refuge: Sp = Spring; S = Summer; F = Fall; W = Winter; YR = Year-Round

<sup>2</sup>US Fish and Wildlife Service. Threatened and Endangered Species System (TESS). Report for the state of Delaware, and Delaware Comprehensive Wildlife Conservation Strategy. 2005. Data from the Excel file developed by the Federal Aid office of US Fish and Wildlife Service, Hadley, MA. Sept. 2006.  
T = threatened; E = endangered

<sup>3</sup>Delaware Comprehensive Wildlife Conservation Strategy. 2005. Data from the Excel file developed by the Federal Aid office of US Fish and Wildlife Service, Hadley, MA. Sept. 2006.

E = endangered; T = threatened  
Does not include state listed plants.

<sup>4</sup>BCR 30 Mid-Atlantic/Southern New England Bird Conservation Region. Final Implementation Plan, June 2008. Melanie Steinkamp, Atlantic Coast Joint Venture, Laurel, MD.

HH = highest priority; H = high priority; M = medium priority

<sup>5</sup>PIF 44 Mid-Atlantic Coastal Plain Partners In Flight. Updated Northeast Physiographic Areas PIF Scores, October 2003. Migratory Bird Office U.S. Fish and Wildlife Service, Hadley, MA.

1a = high continental concern and high regional responsibility  
 1b = high continental concern and low regional responsibility  
 2a = high regional concern  
 2b = high regional responsibility  
 2c = high regional threats  
 3 = additional federally listed species  
 4 = additional state listed species

<sup>6</sup>Delaware Comprehensive Wildlife Conservation Strategy. 2005. Data from the Excel file developed by the Federal Aid office of US Fish and Wildlife Service, Hadley, MA. Sept. 2006.

1 = most in need

2 = in need, not as urgent

Listed all birds, mammals, fish, reptiles, amphibians and non-arthropod invertebrates. For arthropod invertebrates (209 species), only the federal and state listed endangered and threatened species are listed.

<sup>7</sup>US Fish and Wildlife Service. 2002. Birds of conservation concern 2002. Division of Migratory Bird Management, Arlington, Virginia. 99pp. (Online version available at <http://migratorybirds.fws.gov/reports/bbc2002.pdf>)

<sup>8</sup>Federal Trust Fish Species US Fish and Wildlife Service Population Trend Data.

I = increasing; D = decreasing

<sup>9</sup>North Atlantic Regional Shorebird Plan. Clark and Niles 2000.

5 = highly imperiled – all species listed as threatened or endangered nationally, plus all species with significant population declines and either low populations or some other high risk factor.

4 = species of high concern – populations of these species are known or thought to be declining and have some other known or potential threat as well.

3 = species of moderate concern – populations of these species are either a) declining with moderate threats or distributions; b) increasing but with known or potential threats and moderate to restricted distributions; or c) of moderate size.

2 = species of low concern – populations of these species are either a) stable with moderate threats and distributions; b) increasing but with known or potential threats and moderate to restricted distributions; or c) of moderate size.

1 = species not at risk – all other species where there is apparently no current risk of population decline.

<sup>10</sup>Waterbird Plan: James A. Kushlan, Melanie J. Steinkamp, Katharine C. Parsons, Jack Capp, Martin Acosta Cruz, Malcolm Coulter, Ian Davidson, Loney Dickson, Naomi Edelson, Richard Elliot, R. Michael Erwin, Scott Hatch, Stephen Kress, Robert Milko, Steve Miller, Kyra Mills, Richard Paul, Roberto Phillips, Jorge E. Saliva, Bill Sydeman, John Trapp, Jennifer Wheeler, and Kent Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas. Washington, DC, U.S.A.

HI = highly imperiled; H = high risk; M = moderate risk; L = low risk; NR = not currently at risk; - = species to be assessed in Version 2 of the North American Waterbird Conservation Plan

<sup>11</sup>MANEM Waterbird Working Group. 2006. Waterbird Conservation Plan for the Mid-Atlantic/New England/Maritimes Region: 2006-2010. Waterbird Conservation for the Americas ([www.waterbirdconservation.org](http://www.waterbirdconservation.org)).

Table 10 – Regional waterbird population conservation priorities in the Mid-Atlantic/New England/Maritimes region of North America.

HH = highest; H = high; M = moderate; L = low (did not include all the Low species)

<sup>12</sup>North American Waterfowl Management Plan, Plan Committee. 2004. North American Waterfowl Management Plan 2004. Implementation Framework: Strengthening the Biological Foundation. Canadian Wildlife Service, U.S. Fish and Wildlife Service, Secretaria de Medio Ambiente y Recursos Naturales, 106 pp. Population trend 1970 – 2003:

I = increasing; S = stable; D = decreasing; U = unknown